HIGHLIGHTS

A1. Determination of powder compressibility for pharmaceutical applications

A2. Nanoparticle Heterogeneity: Nanomedicine Quality and Composition Defined by SPARTA®

16.03.2026

Managing your life like particles



Newsletter 10 (PCIG N10)

Welcome to the tenth edition of our newsletter!

Join Us in Advancing Scientific Research

RSC INTEREST GROUP
PARTICLE
CHARACTERISATION

Newsletter 10 (PCIG N10) - 16.03.2026

PREFACE

This newsletter aims to serve as a means of internal communication of useful information and strengthen the engagement among the group members. This quarter's newsletter, with the tenth edition (January 2026 – March 2026), focuses on the following topics:

A. Research Highlights by **Lucideon-UK** on the 'Determination of powder compressibility for pharmaceutical applications" and SPARTA® on how to define Nanoparticle Heterogeneity – Nanomedicine Quality and Composition.

B. Get to know: inspiring stories by Sayantan Das, Roberto Cerbino, Guzman Carissimi and Merel Bout.

C. Update corner: 'Meet the Editors' event covering in India and presentation of **upcoming events in the UK and worldwide.**

Editorial team: **Anna Anandita, Mel Disher, Merel Bout, Okba Al Rahal, Stefanos Mourdikoudis, Sayantan Das, Tien Quach**

Graphics team: **Pantelis "Leon" Xydias and Viktoriya Ivasiv**

We would like to express our great appreciation to the PCIG Committee for encouraging and advising us to issue a new edition of PCIG Newsletter. Many thanks for the contribution from the people who are willing to cooperate with us. We look forward to your collaboration in the next editions!



**Welcome to the PCIG Newsletter,
where we network and work together for better particle technologies.**

TABLE OF CONTENTS

A. RESEARCH HIGHLIGHTS

A1. Determination of powder compressibility for pharmaceutical applications 4

A2. Nanoparticle Heterogeneity – Nanomedicine Quality and Composition Defined by SPARTA® 19

B. INSPIRING STORIES

B.1 Get to know 23

B.2 Managing your life like particles 25

C. UPDATE CORNER

C1. My experience with RSC 'Meet the Editors' Event 27

C2. Upcoming events of interest

UK-based events 28

Non – UK and Ireland events of possible interest 30

CONTACT US 39

A. RESEARCH HIGHLIGHTS

A.1 Determination of powder compressibility for pharmaceutical applications

Written by Liam Desmond; Editorially coordinated by Merel Bout and Tom Archer tom.archer@uk.lucideon.com



Dr Liam Desmond holds an MChem (Hons) Chemistry with an integrated Master's degree from Newcastle University and a PhD in a cross-functional field of Chemistry, Chemical and Mechanical Engineering from Newcastle University, which involved using these different fields of science to construct a nano-therapeutic drug delivery system. With over 10 years of experience in both academic and applied research environments, Liam's area of expertise also spans to Computational and Biological Research, Microbiology, Immunohistochemistry, and Biotechnology. More recently, Liam has revisited materials science and formulation chemistry at Lucideon in a scientist role.

Link to white paper: https://www.lucideon.com/uk/lucideon-whitepapers/determination-of-powder-compressibility-for-pharmaceutical-applications

INTRODUCTION

In the formulation of pharmaceutical products, compositions must be precisely tuned to ensure optimal effectiveness. The percentage proportion of each component is crucial and, where dry powders are involved, there may be various grades or versions available with different molecular weights, extent of crystallinity, and so on, as well as a multitude of powders of similar chemistry and behaviour but with slightly different moisture content or particle size and shape. It is therefore important to carefully select the most suitable grade of raw material based on its specific properties.

Powders typically undergo a range of processing steps on the road to final product formulation. Flow (e.g. through silos) is important for product formulation but there is a tendency for some powders to clump together during storage, which can positively or negatively affect the utilisation of these powders in different applications. Equally, flow of multi-component dry powders can lead to phase separation and variable percentages of active ingredient(s) in the final product. Low compressibility powders, which do not easily form cohesive structures under pressure, are often preferred in applications where free-flowing properties are essential. For example, in powder inhalers, pharmaceutical powders with low compressibility are used to ensure smooth aerosolisation and consistent dosing. Similarly, in instant beverage powders such as instant coffee or protein powders, low compressibility helps to prevent clumping, ensuring easy mixing and dissolution in liquids. In contrast, high compressibility powders are crucial in applications where compacting the material into a dense, solid form is necessary. In tablet manufacturing, powders with high compressibility allow for the formation of strong, durable tablets that do not crumble easily.

Based on the significant effect of individual powder compressibility on a finished product's behaviour in industrial applications, it is essential to have a clear means of distinguishing and qualifying this important property of different grades of raw material powders. This challenge has prompted Lucideon to study the compressibility of powders using powder rheology.

The FT4 Powder Rheometer enables a refined assessment of powder behaviour through tests such as compressibility, which uniquely capture how a powder responds as interstitial air is progressively displaced under controlled compaction. This test reflects conditions ranging from freely flowing, aerated states to densely packed, constrained environment, making it particularly valuable for understanding performance in both processing and storage scenarios.

This white paper will explore the application of the FT4 Freeman Powder Rheometer to study compaction behaviour in different powders and the impact this may have on the pharmaceutical industry, thus helping in optimising formulations to reduce production down-time, maximise yields, and maximise efficacy in patients. Furthermore, this paper aims to present real-life case studies demonstrating how the FT4 Powder Rheometer effectively measures the compressibility of various grades of the same powder, as well as different powders with similar properties, aiding in optimal raw material selection for pharmaceutical applications.

WHAT IS POWDER RHEOLOGY?

Simply put, a powder is any solid substance that has been reduced to a state of fine, loose particles. This can be achieved by crushing, grinding, disintegration etc. ("top down" approach) or by precipitation ("bottom up") processing. Powder rheology refers to the study of the behaviour of dry powders as bulk assemblies, consisting of solids and gases. It should not be confused with the rheology of fluid powder suspensions (using e.g. a plate on plate rheometer) that readers may be more familiar with. In powder rheology, the interstitial air between dry particles can be considered a contributing factor to bulk fluidity, facilitating particle movement and influencing overall flow behaviour. Powder rheology provides a detailed understanding of the physical behaviour of powders, their stability, and can lead to a deeper insight into how these properties relate to the mechanical properties of, for example, a final tablet product. This information is essential for choosing the right powder blends, helping to optimise processing, tablet formulation or drug capsule filling and reduce issues like poor flow or granulation.

POWDER COMPRESSIBILITY

Powder compressibility refers to the ability of a powder to decrease in volume under the application of pressure that forces particles closer together. Measuring and controlling this property is imperative in industries such as pharmaceuticals, food processing, and materials science, as it impacts how powders will behave during handling, transportation, storage, and compaction. Powders with different characteristics exhibit varying compressibility profiles, and these differences affect their flowability, packing behaviour, and performance in manufacturing processes (Leuenberger, 1982).

Several factors can influence the compressibility of a powder (Shah, 2023; Brittain, 2001), including:

1. **Particle size and shape:** where smaller or more irregularly shaped particles typically have a higher surface area and may pack more tightly together, leading to a higher compressibility. In contrast, spheres can flow well past each other but pack with significant void space between particles.

2. **Particle size distribution:** A broad particle size distribution typically results in higher packing density and higher compressibility.

3. **Moisture content:** Moisture can function as a lubricant or binder, influencing the powder's ability to compress.

4. **Powder density:** Both bulk density (loose powder) and tapped density (powder after tapping to remove voids) play a role in compressibility. Higher bulk density often corresponds to lower compressibility.

5. **Powder cohesion:** Powders with higher cohesion due to van der Waals forces or electrostatic interactions will be more resistant to compression.

6. **Additives:** The inclusion of flow agents, binders, or other excipients can modify the powder's compressibility.

7. **Flowability:** Poor compressibility can sometimes correlate with poor flowability. Powders that do not compress well under pressure may also have difficulty flowing smoothly in a processing environment.

8. **Packing characteristics:** The ability of a powder to compact under pressure correlates with how densely it will pack into containers or moulds, which can affect product quality (e.g., tablet weight uniformity in pharmaceuticals).

The effect of compressibility is a factor in predicting tablet compression (Odeku, 2007). Powder compressibility ultimately influences tablet hardness, disintegration time, and dissolution rate, which are important in terms of tablet yield, performance, and shelf life or stability. Thus, many evaluation and quality control (QC) tests are employed to understand how powders will behave during processing, storage, and final product formation. QC tests like visual inspections, weight measurements, and moisture content checks are simple and commonly used to ensure product standards, but they often focus on individual aspects, missing broader quality issues. These tests may catch obvious defects but are incapable of identifying subtle problems or systemic production flaws, such as compression capability. They do not guarantee overall product performance, longevity, or user satisfaction, and may fail to detect underlying issues that affect product quality in the long term. An in-depth solution for intrinsic powder property testing, such as compressibility testing, would greatly assist effective and optimised processing of powder-based formulations in the pharmaceutical industry.

Among simple yet effective established analytical tests, the Compressibility Index (CI) is a measure of a material's compressibility, often used to assess the flowability and packing properties of powders. It is typically calculated from the ratio of experimentally derived bulk and tapped density determinations of a powder, with a higher CI indicating greater compressibility. CI is derived from the following equation:

$$\text{Compressibility Index } (CI)(\%) = \frac{\text{Tapped Density - Bulk Density}}{\text{Tapped Density}} \text{ x } 100$$

where:

- **Bulk Density** is the mass of the powder divided by its initial volume before tapping.
- **Tapped Density** is the mass of the powder divided by its volume after repeated tapping, which allows the powder to settle and pack more densely.

A **higher CI value** indicates greater compressibility and lower flowability, while a **lower CI value** suggests lower compressibility and better flow properties.

The CI can help categorise the flow behaviour of powders, including whether they are cohesive, non-cohesive, or prone to no-flow conditions. CI determination enables a direct comparison between different powders, and an assessment of suitability for a given application. The following table (Table 1) helps to classify powders based on their CI value and is represented graphically in Figure 1 at Page 9.

Table 1. Classification of powder flow based on their compressibility index (CI) value

Compressibility Index (CI)	Powder Flow behaviour
<10%	Free-flowing (noncohesive)
10-15%	Fairly free-flowing (non-cohesive)
15-20%	Good flow (slightly cohesive)
20-30%	Cohesive (moderate flow)
> 30%	Very cohesive (poor flow)
> 50%	No flow (extremely cohesive)

- Highly Compressible Powders (e.g., fine talc, lactose, and some excipients): Compressibility Index: High (e.g., 25-40%).
- Moderately Compressible Powders (e.g., powders with larger particle sizes or less cohesive nature): Compressibility Index: Moderate (e.g., 15-25%).
- Low Compressibility Powders (e.g., crystalline powders, coarse powders, or powders with high interparticle cohesion): Compressibility Index: Low (e.g., below 15%).

A limitation of the Compressibility Index test is its reliance on tapping or vibration to induce particle rearrangement, which may not accurately represent the compaction mechanisms occurring under a uniformly applied axial load during tablet compression. This difference can limit the test's relevance to real-world compaction behaviour.

THE RELATIONSHIP BETWEEN POWDER COMPRESSIBILITY AND PHARMACEUTICAL APPLICATION

Achieving a balance between compressibility and other intrinsic powder properties is crucial for optimal powder handling and processing, particularly in industries where both properties play a key role in product quality and manufacturing efficiency (Shen et al., 2022).

In the pharmaceutical industry, whether it is better to have a powder with high or low compressibility depends on the specific application and the desired outcomes of the manufacturing process. High or low compressibility capability plays a crucial role in the formulation of solid dosage forms like tablets and capsules. The definitive breakdown of how compressibility affects pharmaceutical powders and when each type is preferred is described as follows:

High Compressibility Powders that compact easily under applied pressure and have a high CI are generally desired for tablet formation. Tablets are typically formed by compressing a powder into a solid mass, and powders that are highly compressible are easier to compact into uniform tablets with good mechanical strength and consistency. Powders that exhibit high compressibility produce denser tablets, necessary for achieving the desired dose uniformity. Highly compressible powders can be useful in controlled release formulations, where the powder's ability to compact can help modulate the release rate of the active pharmaceutical ingredient (API). In granulation and blending processes, highly compressible powders may be beneficial as the powder particles need to form larger granules that can be easily compressed into tablets.

High Compressibility Powders, however, are linked to several negative issues. Powders can have a lower flowability, which can be problematic during mixing, dosing, or filling operations. High compressibility can lead to clumping, bridging, or inconsistent blending. Moreover, highly compressible powders may have higher cohesion, causing particles to stick together or form agglomerates. This can reduce the efficiency of filling and processing equipment as powders with high cohesion may stick to machine surfaces, clog dosing mechanisms, or fail to flow smoothly into molds or capsules. In tablet manufacturing, excessive cohesion can cause issues such as powder sticking to punches and dies, leading to defects such as capping or lamination. Similarly, in capsule filling, poor flowability can result in inconsistent fill weights, affecting dosage accuracy and product quality (Du et al., 2023).

Low Compressibility Powders that do not compact easily under applied pressure and have a low CI are resistant to volume reduction under applied pressure and typically have lower surface area and larger particle sizes in comparison to highly compressible powders. They resist packing and consolidation under pressure. They are generally desired for powder flow and handling applications. This is because low compressibility powders are typically more free-flowing, which can be an advantage in processes requiring smooth powder flow such as capsule and sachet filling or powder dosing. Capsule filling does not involve significant compaction of the powder. Instead, it relies on powder flow and dosing methods to fill capsules without excessive compression. Unlike tablet manufacturing, where powder is compressed into a solid form, capsule filling primarily focuses on achieving an accurate dose while maintaining good powder flow.

Low compressibility powders are easier to handle in automated equipment since they resist clumping and bridging. In powder blending, their low compressibility promotes smoother flow, reducing the risk of clumps and ensuring more uniform mixing of APIs and excipients (Madian et al., 2018; Du et al., 2023).

Poor compressibility can lead to issues like low tablet hardness and poor mechanical strength, which may cause tablets to break or crumble easily. Inconsistent dosing is another challenge that may arise, where, despite good flow into a die, low compressibility powders may not densify well during the tablet compression process resulting in inconsistent tablet weight or dose variation if not properly controlled. The lack of sufficient compression may also impact the release profile of the drug. Finally, the ability of powders with differing compressibility capabilities to flow past each other can, where there are significant differences in size, specific gravity etc., assist unwanted powder segregation.

The differences in flowability and compaction properties between high and low compressibility powders highlight the importance of selecting the right type of powder for different pharmaceutical processing methods and final products. For tablet manufacture, the priority would be to use a powder with moderate to high compressibility, ensuring that it can be compacted into strong, uniform tablets. Powders with good compressibility are easier to form into tablets with consistent weight, hardness, and dissolution characteristics. For capsule filling, low compressibility powders would be preferred as they flow more easily and fill the capsule shell efficiently. This then denotes the need for compressibility tests on powders to ensure this factor can be closely monitored to predict the powder compaction for tablet formation outcome (Shen et al., 2022).

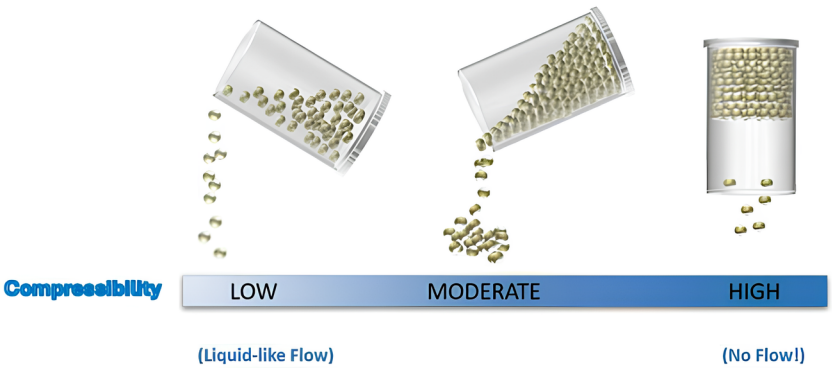

Figure 1. The spectrum of powder compressibility and the flowability-based behaviours associated with each end (FT4 Powder Rheometer® - Alfatest)

Conventional tests such as Compressibility Index, Hausner ratio, flow through orifice, and angle of repose, offer indirect indications of a powder's flowability and packing behaviour, which in turn influence its compressibility. These methods can help differentiate between powders with varying packing efficiency or cohesiveness, providing a basic understanding of how a material may respond to compaction and its subsequent compressibility characteristic. While traditional measurements provide useful initial insights, they often fail to capture the complexities of powder behaviour in real-world manufacturing. To overcome these limitations, the FT4 Powder Rheometer delivers a more detailed and predictive assessment of powder flow and performance.

FT4 POWDER RHEOMETER COMPRESSIBILITY TEST METHOD PROTOCOL

A sophisticated rheology system is crucial for accurately characterising powders under controlled variations in humidity and airflow, from pneumatic conveyance to storage and tablet pressing. This analysis enhances understanding of properties like compressibility, benefiting pharmaceutical companies.

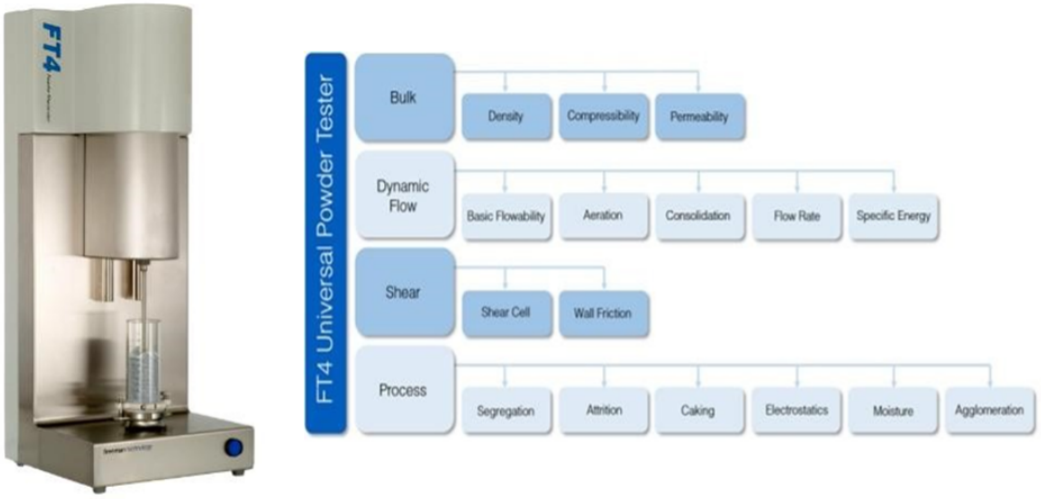

Figure 2. (Left) - the FT4 Powder Rheometer Equipment; (right) - the full range of FT4 measurement capabilities (FT4 Powder Rheometer – GAT Scientific)

The FT4 Powder Rheometer (Figure 2, left) is a universal powder tester designed for measuring the behaviour of powders. The FT4 is a unique tool for powder characterisation in that it quantifies the resistance of the powder to flow, as the powder is forced into motion. From this, a range of intrinsic and bulk powder properties can be derived (outlined in Figure 2, right), including compressibility (the focus of this white paper). During a FT4 compressibility test, a powder sample is placed in a cylindrical chamber. The powder is subjected to incremental increases in applied pressure, and the change in powder volume is measured, providing insights into the powder's compressibility. The FT4 Powder Rheometer records this compressibility by measuring how the powder responds as the pressure applied increases, offering insights into its packing behaviour and the ease with which it can be compressed. In addition, as increased load or pressure is applied, it is possible to measure permeability, or how easy it is to flow air through the compact, and the compact strength when subjected to shear forces. The latter is important as it links compressibility to compact strength. As noted earlier, a key limitation of the CI test is its reliance on tapping to induce particle rearrangement, which does not fully replicate the uniform compressive forces seen during tableting. The FT4 Powder Rheometer addresses this by applying axial stress directly across the powder bed, providing a more representative evaluation of compressive behaviour under realistic manufacturing conditions. While the FT4 Powder Rheometer does not directly measure the CI, it provides data on flowability and cohesiveness that can be used to estimate compressibility behaviour. By analysing powder behaviour under pressure, the FT4's compressibility data can be correlated with CI values.

Whilst the CI calculation is a useful method for assessing a powder's compressibility, it relies on bulk and tapped density measurements, which provide only a basic estimation. In contrast, the FT4 Powder Rheometer offers a more advanced and accurate approach by performing a dedicated compressibility step that directly leads to a measurement of how a powder's volume changes under a controlled range of applied normal stresses. This test provides a compressibility profile in a single step, delivering a final compressibility percentage without the need for separate bulk and tapped density measurements. By capturing real-time powder behaviour under pressure, the FT4 offers a more precise and dynamic assessment of compressibility, making it a superior alternative to traditional methods.

The following graph (Figure 3) (Madian et al., 2018) illustrates a typical compressibility curve obtained from FT4 measurements, showing how different powders exhibit varying compressibility values across a range of applied stresses. Powder compressibility can be categorised based on where the curve falls within specific regions of the graph. For example, powders with low compressibility will show relatively flat curves, indicating minimal volume reduction under stress and free-flowing as a powder (based on the inverse relationship as outlined previously), while highly compressible powders will have steeper curves, reflecting significant densification and inferior flow behaviour. This visual representation makes it easy to classify powders and determine their suitability for different pharmaceutical processing methods, as well facilitating an easier comparison of the relative performance of different powders against each other.

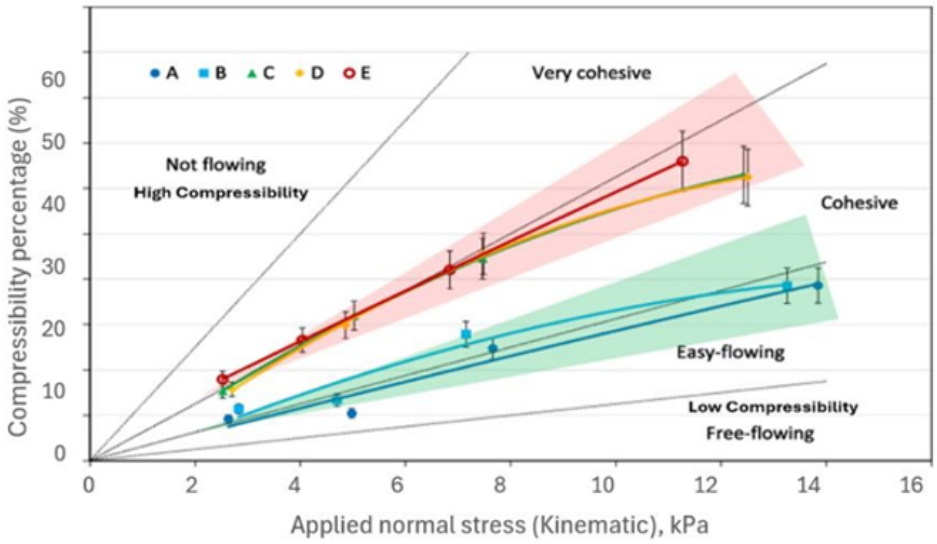

Figure 3. The classification of different powder's (A-E) flow based on compressibility index (CI) (Madian et al., 2018)

OUR WORK

Lucideon has used the FT4 Powder Rheometer to support collaborative projects as well as internal research and development activities, where the high-quality data associated with compressibility testing has provided extra levels of material understanding. This deeper understanding of material properties and structure is often critical in achieving the necessary improvements in both product formulation and processing. The following two case studies use compressibility data from the FT4 Powder Rheometer to draw conclusions to assist in optimising the performance of a pharmaceutical product.

Case study 1: Different Grades of Sodium Carboxymethyl Cellulose (CMC)

CONCEPT

The concept of this case study was the investigation of different biopolymers used for their adhesive properties. A range of different polymers were initially screened, but ultimately Sodium Carboxymethyl Cellulose (CMC) was selected as the favoured biopolymer. To ensure reliable comparison between the different CMC grades, all powders underwent the same prior handling, conditioning, and testing procedures.

CMC is a versatile and widely used biopolymer, often employed as a thickener, stabiliser, emulsifier, or binder in various industries such as pharmaceuticals, food, cosmetics, and paper production (Sun et al., 2024)., In pharmaceutical products, CMC can act as a binder and disintegrant, helping to control key tablet properties such as hardness, dissolution, and disintegration rates. A grade with optimal compressibility can contribute to the controlled, slow release of the API over time, improving efficacy and patient compliance (Fallourd & Viscione, 2009). However, there are several different grades associated with factors including differing molecular weights. This means there is potentially a range of compressibility values for different CMCs, which can have a huge influence on their performance and handling properties and subsequently affect the properties of the final product. Knowing the compressibility of different grades of CMC was seen as critical in determining which grade of CMC was going to be optimal for the desired application. Compressibility measurements on different grades of sodium carboxymethyl cellulose (CMC) were used to identify the most suitable option for specific applications based on compressibility and flow capability, allowing future clients to reduce the number of mixed powder trials by eliminating molecular weight as a variable and ultimately saving both time and development effort.

EXPERIMENTAL

The compressibility of the following molecular weight CMC grades was evaluated at 90,000 Da (90K), 250,000 Da (250K) and 700,000 Da (700K). The results are outlined in Table 2 and represented as a function of increasing applied normal stress in Figure 4.

Table 2. Compressibility results and subsequent powder property assignment to the three different grades of sodium carboxymethyl cellulose (CMC) assessed

Sodium carboxymethyl cellulose (CMC) grade	Average Compressibility (%)	Powder property	Ranking (based on flowability)	Ranking (based on tablet formation capability)
90K	5.75 ± 0.26	Very low compressibility, non-cohesive (very free-flowing) powder	3	1
250K	5.92 ± 0.14	Very low compressibility, non-cohesive (very free-flowing) powder	2	2
700K	3.55 ± 0.31	Very low compressibility, non-cohesive (very free-flowing) powder	1	3

RESULTS

It can be observed in Figure 4 that the higher molecular weight CMC (700K) had a lower compressibility (3.55 ± 0.31%) after a total load of 15 kPa stress was applied, compared to the lower molecular weight CMCs (90K- 5.75 ± 0.26%, 250K- 5.92 ± 0.14%), under the same stress conditions (15 kPa).

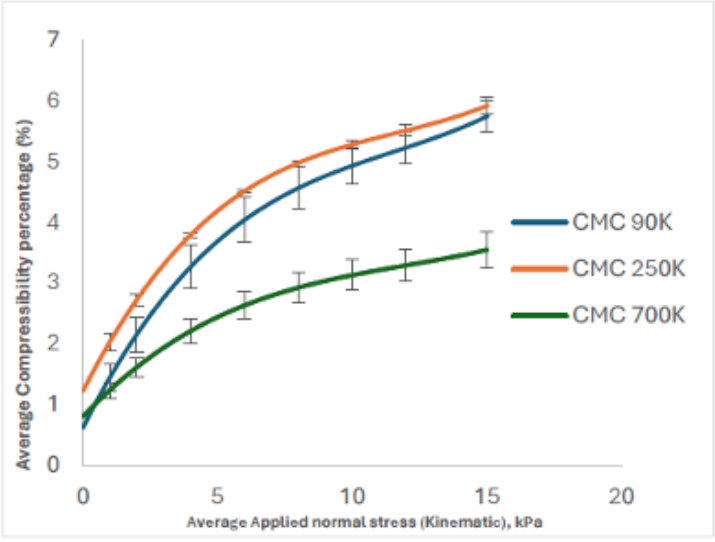

Figure 4. The average powder compressibility test results of different grades of CMC: 90K, 250K, 700K

DISCUSSION

Lower grade CMCs (90K, 250K) have a higher compressibility than higher grades of CMC (700K) so it can therefore be stated that the higher molecular weight grades of CMC are likely to be freer flowing than lower grades of CMC. Lower molecular weight CMCs are composed of smaller, finer particles that tend to be more cohesive. This results in a significantly weaker interparticle attraction prior to compaction but an ability to rearrange and pack more densely under pressure, hence a higher compressibility. On the opposite scale, higher MW grade CMCs feature larger, bulkier particles, leading to reduced cohesion, making them less prone to densification under stress and less compressible.

Nevertheless, as all three powders compressibility values are below 10%, they are all non-cohesive, free-flowing powders based on the CI profile outlined in Table 1. Therefore, in tablet formation, no individual CMC grade would be hugely beneficial compared to the others based on their compressibility values. The 90K and 250K grades are, however, likely to have a better balance between flow and efficient pressed tablet formation.

CONCLUSIONS

The following was concluded from these results:

- Higher molecular weight grades of CMC have lower compressibility, making them less suitable for tablet formation than lower molecular weight grades of CMC. However, they may offer some advantages in capsule filling applications, though the difference between the grades is not substantial. CMC helps improve cohesion between powder particles, which can be important in capsule plug formation, ensuring that the fill material holds together and can be dosed consistently. While not a classic flow agent, certain grades of CMC, especially those with lower viscosity, can help to modify flow properties of the powder blend, making it easier to fill capsules consistently.

- Lower molecular weight grades of CMC exhibit better compressibility, making them more suitable for tablet formation, but they are slightly less effective for capsule filling. Nevertheless, the overall differences between the different grades are not significant.

By comparing different grades of CMC, the application of this material in industrial pharmaceutical applications can be optimised. Formulators can, in the future, be able to strike a balance between tablet strength, disintegration, and manufacturability, ensuring the final product meets quality and performance standards.

Case study 2: Different Amino Acids in the Use of Collagen Tablet Formation

CONCEPT

The second case study highlights the role of amino acids in the pharmaceutical industry. In peptide-based therapeutics, understanding amino acid compressibility can aid in designing peptides with specific structural properties, enhancing their stability and functionality under physiological conditions (Wang et al., 2022). Amino acids are essential in drug design, whether used in free form, as part of peptides, or within larger biologics like monoclonal antibodies, contributing to treatments for metabolic, neurological, and cardiovascular diseases (Bongioanni et al., 2022).

Amino acids are also commonly used in pharmaceutical supplements. Some of those amino acids are: Glycine, Lysine, Proline, and Ascorbic Acid (J. Z. Williams, 2002). When formulating such amino acids, frequently included in formulations aimed at supporting connective tissue health represented as a function of increasing applied supplements, understanding the compressibility of amino acid powders is crucial; this is because, for optimising tablet or capsule production, ensuring suitable mechanical properties for manufacturing and stability is critical. Knowing the compressibility of different amino acids was seen as a critical process in helping differentiate and select the most beneficial amino acid for tablet formation, based on the concept of compressibility vs tablet formation as discussed in this paper.

EXPERIMENTAL

The compressibility of the following amino acids was evaluated: Glycine, Lysine, Proline and Ascorbic Acid. The compressibility results of the four amino acids are outlined in Table 3 and Figure 5 below.

RESULTS

It can be observed in Figure 5 that Lysine had the lowest compressibility after a total of 15kPa stress was applied during the compressibility test (2.7 ± 0.3%), followed by Glycine (11.0 ± 0.3%), Ascorbic acid (12.9± 0.3%), with Proline demonstrating the highest value of compressibility by the end of the compressibility test (33.2 ± 1.4%). Note that all comparisons between the 4 amino acids' compressibilities by t-Test statistical analysis showed p-values of less than 0.003, providing sufficient evidence to conclude that a significant difference or relationship exists between the groups being assessed.

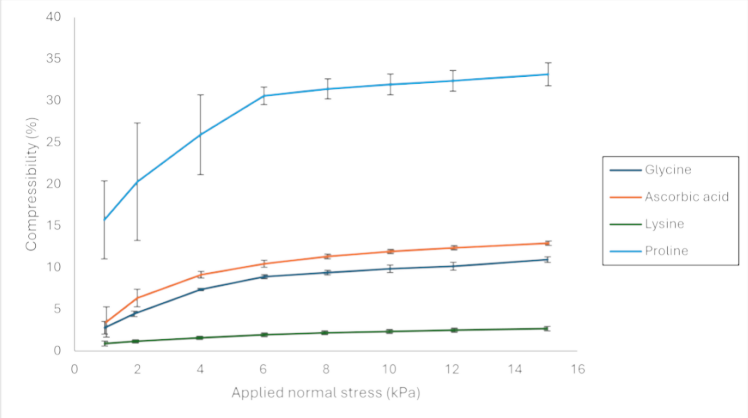

Figure 5. The average powder compressibility test results of amino acids – glycine, ascorbic acid, lysine, and proline

Table 3. Compressibility results and subsequent powder property assignment to the four amino acids assessed

Amino acid	Average Compressibility (%)	Powder property	Ranking (based on flowability)	Ranking (based on tablet formation capability)
Proline	33.2 ± 1.4	highly compressible, very cohesive (poor flow) powder	4	1
Ascorbic acid	12.9 ± 0.3	low compressible, fairly free-flowing (non-cohesive) powder	3	2
Glycine	11.0 ± 0.3	low compressible, fairly free-flowing (non-cohesive) powder	2	3
Lysine	2.7 ± 0.3	very low compressible, free-flowing (non-cohesive) powder	1	4

DISCUSSION

Lysine (2.7 ± 0.3%) which displayed the lowest compressibility is clearly highly resistant to compression. This could be attributed to its crystalline structure (P. A. Williams, 2015), which may provide rigidity and limit deformation under applied stress.

Glycine exhibited moderate compressibility but remains relatively stable under pressure. This could be attributed to the small molecular size and crystalline nature of that amino acid (Rodríguez et al., 2019), and may contribute to moderate packing efficiency.

Ascorbic acid possessed a slightly higher compressibility than glycine, but the relatively small increase and higher tendency to compress compared to lysine and glycine suggests a less rigid particle structure. This can be attributed to the presence of hydrogen bonding, while its relatively large molecular structure (Arayachukiat et al., 2017) could influence its compressibility properties.

Proline showed significantly higher compressibility than the other three amino acids assessed, indicating a high degree of deformation under stress. This is likely due to its molecular structure, which may have weaker intermolecular forces and greater particle deformability (Zhan & Ytreberg, 2015).

This overall trend in the four amino acids can be ascribed to several key factors:

- Molecular structure & crystallinity: highly crystalline substances (e.g., lysine, glycine) tend to resist compression, while more amorphous or flexible structures (e.g., proline) exhibit greater compressibility.

- Intermolecular forces: strong hydrogen bonding and rigid structures (ascorbic acid) reduce compressibility, while weaker interactions (in proline) allow for more deformation.

- Particle size & shape: smaller or more uniform particles may pack more efficiently, reducing compressibility (glycine), whereas irregular shapes can lead to higher compressibility (proline).

Based on these CI values, the order of increasing compressibility value and hence better anticipated performance in collagen supplementary tablet formation is proline > ascorbic acid > glycine > lysine, as outlined in Table 3, column 5.

Conversely, the capability of these amino acids in terms of capsule filling, based on compressibility, as well as better flowing powder would be proline < ascorbic acid < glycine < lysine, as outlined in Table 3, column 4.

When considering these ingredients for formulations, other factors would also need to be taken into account, such as particle size and shape, moisture content, particle distribution, and overall safety for patient consumption. Purely in terms of compressibility, however, these amino acids display a definitive ranking of employment in different pharmaceutical dosage forms.

CONCLUSIONS

This compressibility case study illustrates a valuable concept for pharmaceutical applications, as it will ultimately assist in assessing the overall suitability of different amino acid powders for tablet and capsule formulations. Understanding how each amino acid responds to compression ensures optimal tablet stability, compactness, and manufacturability. Comparing these differences allows for better formulation decisions, improving drug efficacy, production efficiency, and product consistency.

The compressibility of powders is a crucial characteristic that affects many aspects of powder handling and processing. By using instruments like the FT4 Powder Rheometer, one can gain valuable insights into powder behaviour under pressure, which assists the selection and optimisation of powders for specific applications such as tablet formation or capsule filling.

Depending on the type of powder, changes in volume by compression will range from significant to none, which, if anticipated and quantified, would enable the selection of appropriate powders for specific applications that require a certain end of the compressibility spectrum.

Although compressibility measurements offer useful information on particle rearrangement and densification under applied stress, they do not directly predict final compact strength, which is governed by the formation of cohesive interparticle bonds. Where required, complementary FT4 Powder Rheometer tests can provide additional insight into the compactability and mechanical integrity of the formulation. Nevertheless, this compressibility-focused investigation offers valuable insight into the early-stage assessment of excipient performance and contributes to a more efficient approach to tablet formulation development.

As stated, for tablet formation, high compressibility is generally preferred as it ensures that the powder can be compressed into dense, strong tablets. Powders that are more compressible will form tablets that are more likely to have consistent weight, uniformity, and sufficient hardness, which are key to ensuring the drug's efficacy and patient safety. For capsule filling and handling powders, low compressibility powders possess improved flowability, reducing issues like clumping or inconsistent dosing. If flowability is a significant challenge, some degree of granulation may be implemented to modify the powder’s characteristics.

Ultimately, the ideal compressibility of a powder for application will depend on the specific pharmaceutical process or product and desired outcome in question. The FT4 Powder Rheometer nevertheless proves itself as a highly valuable tool for measuring, and therefore predicting, compressibility.

References:

Arayachukiat, S., Kongtes, C., Barthel, A., Vummaleti, S. V. C., Poater, A., Wannakao, S.,Cavallo, L., & D'Elia, V. (2017). Ascorbic Acid as a Bifunctional Hydrogen Bond Donor for the Synthesis of Cyclic Carbonates from CO2 under Ambient Conditions. ACS Sustainable Chem. Eng., 5, 6392–6397. https://doi.org/10.1021/acssuschemeng.7b01650

Bongioanni, A., Bueno, M. S., Mezzano, B. A., Longhi, M. R., & Garnero, C. (2022). Amino acids and its pharmaceutical applications: A mini review. International Journal of Pharmaceutics, 613, 121375. https://doi.org/10.1016/J.IJPHARM.2021.121375

Brittain, H. G. (2001). Solid-state analysis. Separation Science and Technology, 3(C), 57–84. https://doi.org/10.1016/S0149-6395(01)80005-2

Du, H., Lu, H., Tang, J., & Liu, H. (2023). Characterization of powder flow properties from micron to nanoscale using FT4 powder rheometer and PT-X powder tester. Particuology, 75, 1–10. https://doi.org/10.1016/J.PARTIC.2022.05.014

Fallourd, M. J., & Viscione, L. (2009). Ingredient selection for stabilisation and texture optimisation of functional beverages and the inclusion of dietary fibre. Functional and Speciality Beverage Technology, 3–38. https://doi.org/10.1533/9781845695569.1.3

Leuenberger, H. (1982). The compressibility and compactibility of powder systems. International Journal of Pharmaceutics, 12, 41–55. https://doi.org/10.1016/0378-5173(82)90132-6;

Madian, A., Saleh, K., Ablitzer, C., Matheron, P., Leturia, M., & Bernard-Granger, G. (2018). Influence of the amount of fine particles on rheological properties of uranium dioxide powders. Nuclear Engineering and Technology, 52, 1714. https://doi.org/10.1016/j.net.2020.01.012

Odeku, O. (2007). The Compaction of Pharmaceutical Powders. Pharmaceutical Reviews.

Rodríguez, J. S., Costa, G., da Silva, M. B., Silva, B. P., Honório, L. J., de Lima-Neto, P., Santos, R. C. R., Caetano, E. W. S., Alves, H. W. L., & Freire, V. N. (2019). Structural and Optoelectronic Properties of the α-, β-, and γ-Glycine Polymorphs and the Glycine Dihydrate Crystal: A DFT Study. Crystal Growth & Design, 19, 5204–5217. https://doi.org/10.1021/acs.cgd.9b00593

Shah, D. S. (2023). A concise summary of powder processing methodologies for flow enhancement. Heliyon, 9, e16498. https://doi.org/doi:10.1016/j.heliyon.2023.e16498

Shen, C., Li, Y., & Xu, X. (2022). Analysis of the compressibility of edible powders under low pressure. Journal of Food Engineering, 316, 110828. https://doi.org/10.1016/J.JFOODENG.2021.110828

Sun, F., Cheng, T., Ren, S., Yang, B., Liu, J., Huang, Z., Guo, Z., & Wang, Z. (2024). Soy protein isolate/carboxymethyl cellulose sodium complexes system stabilized high internal phase Pickering emulsions: Stabilization mechanism based on noncovalent interaction. International Journal of Biological Macromolecules, 256, 128381. https://doi.org/10.1016/J.IJBIOMAC.2023.128381

Williams, J. Z. (2002). Effect of a specialized amino acid mixture on human collagen deposition. Annals of Surgery, 236, 369–374. https://doi.org/doi:10.1097/00000658-20020900000013

Williams, P. A. (2015). L-Lysine: exploiting powder X-ray diffraction to complete the set of crystal structures of the 20 directly encoded proteinogenic amino acids. Angew. Chem. Int. Ed., 54, 3973–3977.https://doi.org/10.1002/anie.201411520

Zhan, Y. A., & Ytreberg, F. M. (2015). The cis conformation of proline leads to weaker binding of a p53 peptide to MDM2 compared to trans. Archives of Biochemistry and Biophysics, 575, 22– 29. https://doi.org/10.1016/j.abb.2015.03.021

A2. Nanoparticle Heterogeneity – Nanomedicine Quality and Composition Defined by SPARTA®

Written by Ben Peacock, Editorially coordinated by Mel Disher

INTRODUCTION

Understanding nanoparticle heterogeneity is central to the design of reliable, high-performance drug delivery systems. Differences in composition, structure and biochemical content across individual particles can strongly influence stability, cellular interactions and functional behaviour. However, most analytical techniques rely on bulk measurements that obscure particle-to-particle variability, making it difficult to determine particle variation and heterogeneity.

Single Particle Automated Raman Trapping Analysis (SPARTA®) measures the Raman spectra of individual nanoparticles in solution, enabling detailed chemical characterisation at the single-particle level. Given that different molecular components, such as ionisable lipids, cholesterol, and proteins or peptides, produce unique Raman scattering signatures, SPARTA® can analyse multiple constituents simultaneously without the need for labels.

The relative intensity of the scattering, proportional to the quantity of the component, enables direct assessment of compositional heterogeneity, hybridisation efficiency and loading of cargo or targeting ligands at the single-particle level. This article highlights two recent studies where SPARTA® was used alongside complementary structural or biochemical methods to understand nanoparticle quality, hybridisation and responsiveness, demonstrating how composition and function can be resolved one particle at a time.

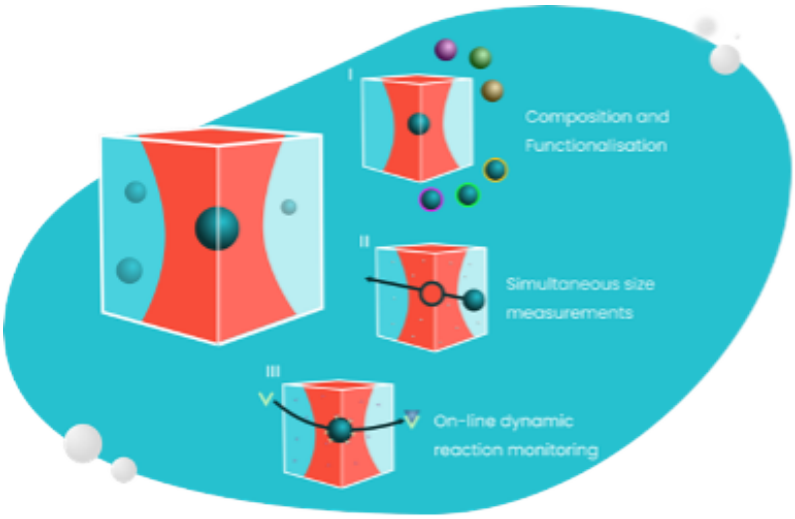

Figure 1. Schematic of the SPARTA® used with nanoparticles held in the optical trap from Raman scattering measurements of biochemical components and particle heterogeneity.

Case Study 1: Confirming True Hybrid Extracellular Vesicles (HEVs) for mRNA Delivery

Messenger RNA (mRNA) therapeutics hold enormous promise, but their success depends on delivery systems capable of both efficient loading and targeted cellular uptake. Extracellular vesicles (EVs) are naturally biocompatible nano-sized carriers of therapeutic payload, yet they struggle to encapsulate large nucleic acids such as mRNA. Lipid nanoparticles (LNPs), by contrast, excel at mRNA loading but can require targeting molecules and controlled formulation design to improve specific uptake. To combine the strengths of both systems, researchers at AstraZeneca engineered hybrid extracellular vesicles (HEVs) by fusing mRNA-loaded LNPs with EVs. Confirming true molecular-level fusion can be difficult with bulk analytical methods, requiring measurement of composition at the single-particle level.

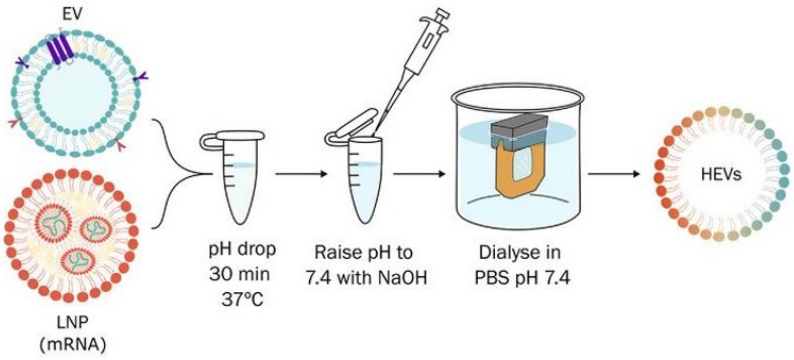

Figure 2. Schematic of the hybridisation protocol used to combine qualities of LNP and EV nanoparticles in hybrid extracellular vesicles (HEVs). Ref [1]

Using SPARTA®, the team performed label-free biochemical fingerprinting of individual nanoparticles across HEV formulations and their EV and LNP controls. By collecting Raman spectra from individual particles, SPARTA® revealed whether lipid, protein, and nucleic acid-associated signatures from either EVs or LNPs co-existed within a single vesicle as direct evidence of hybridisation. Univariate analysis of signatures linked to proteins, lipids and nucleic acids showed that HEVs displayed intermediate profiles between EVs and LNPs, while multivariate fingerprint analysis positioned HEVs as a particle population with a distinct compositional profile lying between that of EVs and LNPs. Together, these measurements confirmed that the fused particles were true hybrids, not artefactual mixtures, whilst highlighting the proportion of non-hybrid particles resembling pure EV or LNP. Beyond confirming fusion, SPARTA® exposed substantial particle-to-particle heterogeneity in HEV composition, providing insights for process and formulation optimization when combined with efficacy data.

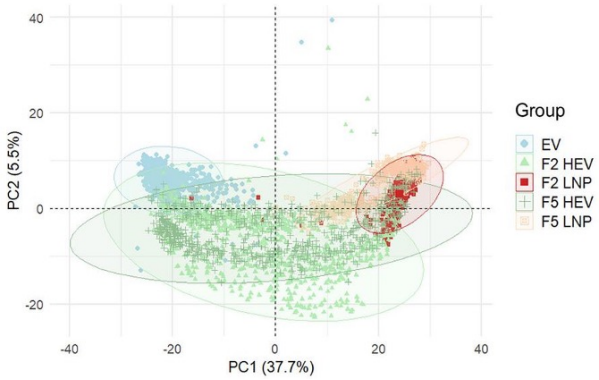

Figure 3. SPARTA analysis of HEV nanoparticles: multivariate Principal Component Analysis (PCA) of full Raman spectra shows EVs, LNPs and HEVs forming separate clusters, confirming HEVs hybrid composition. PCA on all groups showed an overlap in F2 and F5 LNP clusters and HEV F2 and HEV F5 clusters, and EVs clustering independently. PC1 primarily differentiated features of EVs from LNPs, with PC1 scores showing important differences among the three nanoparticle groups. PC2 differentiated HEVs from both EVs and LNPs. For more details see Figure 6 of the Ref [1].

Case Study 2: Monitoring Enzyme-Driven Compositional Changes in Lipid Nanoparticles

In a second example, SPARTA® was used to examine how lipid nanoparticles (LNPs) respond to enzymatic stimuli, providing insight into the design of biologically triggered nanocarriers. LNPs incorporating phosphatidylcholine (PC) were exposed to increasing amounts of phospholipase D (PLD), an enzyme implicated in several disease pathways. PLD converts PC into phosphatidic acid (PA), altering membrane charge and potentially reorganising internal structure. Understanding how this reaction proceeds within individual nanoparticles is essential for designing enzyme-responsive LNPs.

Conventional structural methods such as SAXS or SANS can monitor changes to internal architecture, but they cannot track chemical transformations within single nanoparticles, nor can they capture how individual particles respond differently when exposed to the same enzymatic conditions. Label-based assays can introduce artefacts, complicating interpretation.

Using SPARTA®, researchers monitored the Raman signatures of single nanoparticles repeatedly over time, tracking the decline of PC-associated peaks and the formation of PA-associated signals as PLD acted on each nanoparticle. By collecting data across hundreds of nanoparticles, they observed both overall trends and particle-specific differences in reaction kinetics. Adjusting PLD concentration altered the rate of chemical conversion, allowing direct comparison of enzymatic responsiveness under controlled conditions.

SAXS and SANS measurements conducted in parallel showed how these chemical changes reshaped membrane curvature, internal water channels and overall nanoparticle morphology. The combined dataset linked composition, structure and functional behaviour at the single-particle level. These results highlighted that PLD can remodel the entire LNP membrane more efficiently than comparable vesicles and that membrane structure strongly modulates enzymatic activity — important considerations for engineering disease-specific, stimuli-responsive delivery systems.

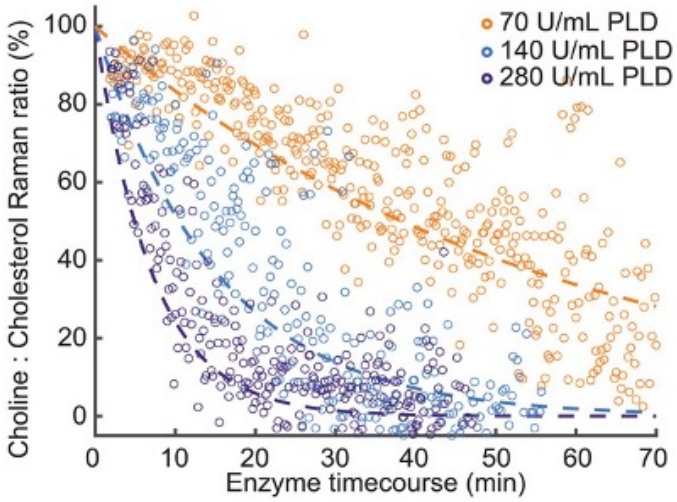

Figure 4. Bivariate plot of time against choline:cholesterol ratio illustrating PC-to-PA conversion over time in individual LNPs analysed with SPARTA®. Ref [2]

Discussion: Quantifying Nanoparticle Quality Through Single-Particle Composition

As nanomedicine continues to evolve, understanding how individual nanoparticles differ in composition and behaviour is becoming essential for engineering reliable drug delivery systems. Bulk measurements often mask the variability that influences stability, responsiveness, and performance - whereas new single particle modalities help researchers link composition, structure, and function more directly. As nanoparticle designs become more sophisticated, tools that deliver this kind of single-particle clarity will continue to play a vital role in guiding formulation development and ensuring performance.

These examples demonstrate that assessing nanoparticle quality increasingly requires methods capable of resolving single-particle differences rather than relying solely on population averages. SPARTA® enables the measurement of compositional variability, hybridisation fidelity and reaction dynamics directly and in a label-free manner, offering a complementary tool for particle characterisation across complex nanoscale systems.

References:

[1] A. F. Louro, I. Gomes, C.-E. Lu, et al. “Engineering Hybrid Extracellular Vesicles for Functional mRNA Delivery.” Adv. Funct. Mater. 36, e09636 (2026) https://doi.org/10.1002/adfm.202509636

[2] Barriga, H.M.G. et al. ‘Coupling lipid nanoparticle structure and automated single-particle composition analysis to design phospholipase-responsive nanocarriers,’ Adv. Mater., 3, 2200839 (2022) https://doi.org/10.1002/adma.202200839

B. INSPIRING STORIES

Do not hesitate to share your stories to motivate other researchers and students. You can write about the people, the events that motivated you throughout your learning, working and research (either the good or the bad things that happened). We look forward to hearing from you.

B.1 Get to know

Collected by Tien Thuy Quach

Sayantan Das



I completed my Dual MBA-PhD Degree in Material Science Engineering in 2015. My research focuses on colloidal particles, specifically synthesis and deposition techniques for sensor applications. I have worked as a Senior Process Engineer in the industry, where I was involved in scaling up the production of Silica nanoparticles from Rice husk. Currently, I am serving as an Assistant Professor and Program Coordinator for the Computational, Engineering, and Mathematical Sciences Department at Texas A&M University-SA. My research involves nanoparticle-based applications, making particle characterization essential. I am particularly interested in utilizing cost-effective processes to characterize materials in order to reduce the barrier of high-end equipment needs.

Roberto Cerbino



Roberto Cerbino is a Full Professor of Experimental Soft Matter Physics at the University of Vienna, Faculty of Physics. He obtained his PhD in Applied Physics from the University of Milan under the supervision of Marzio Giglio, and subsequently held academic positions in Milan and Fribourg, as well as visiting appointments in UOttawa, ENS Lyon, and ESPCI Paris.

His research lies at the interface of soft matter physics and biophysics, with a strong emphasis on quantitative microscopy, phase imaging, scattering, and rheology, combined with advanced image- and data-analysis methods. In this framework, he has made seminal contributions to differential dynamic microscopy (DDM), now widely used alongside Dynamic Light Scattering (DLS) to characterise dynamics in crowded, active, and biological systems, and applies these approaches to investigate the structure, dynamics, and phase behaviour of passive, active, and living soft-matter systems, including cytoskeletal networks, biomolecular condensates, collective cellular assemblies, and non-equilibrium fluctuations in complex fluids.

Roberto has extensive experience in space-based soft-matter experiments, including ESA missions such as GRADFLEX, NEUF-DIX, and GTACS and has served as Coordinator of the ESA Facility Definition Team for Soft Matter & Biophysics. He is currently a member of multiple space advisory bodies, Associate Editor of Soft Matter (RSC), and series editor for Soft and Biological Matter (Springer).

Guzmán Carissimi

Guzmán is a Senior Scientist in the Particle & Image Analysis team at AstraZeneca, supporting pharmaceutical development through advanced particle characterisation. His expertise includes particle size and shape analysis, image-based techniques, and the interpretation of complex particulate data to inform material and process understanding.



He holds a PhD from the University of Murcia and focuses on linking particle attributes to product performance and manufacturability, contributing to robust drug development and manufacturing strategies. Guzmán is passionate about applying innovative characterisation approaches to solve practical challenges in pharmaceutical material science and actively supports knowledge sharing within the particle characterisation community.

B.2 Managing your life like particles

Written by Merel Bout



After completing my Pharmacy degree, I began working in the GMP laboratory at Tiofarma, a Dutch CDMO company. After a year, I was given the opportunity to pursue a PhD, exploring how active ingredients interact with excipients to improve the stability of medicines.

In our research, we study how particles move, interact, and organize into stable systems. In many ways, my day feels similar: tasks, deadlines, and responsibilities are all like particles that need to fit into the "system" of my schedule.
One framework that has helped me think about this is the 'Pickle Jar Theory' of time management [1]. Let's imagine our day as a glass jar that needs to be filled with different types of "particles":

- Rocks: the largest, most important tasks (high-energy particles that shape the system)
- Pebbles: smaller but still meaningful tasks
- Sand: tiny, less critical tasks that fill gaps
- Water: time for rest, creativity, and personal life



[1]

Just as in particle organization, the order matters. If you let the sand or pebbles settle first, there may not be enough space for the rocks that actually define the structure of your day [1]. By starting with the rocks, I discovered that my day has more space, energy, and stability.



[1]

I'm still learning to apply this principle consistently. Some days, the sand creeps in, and my day feels chaotic. Other days, the rocks are in place, and the flow feels almost effortless. But thinking of tasks as particles helps me see that time, like matter, needs organization and balance. It's a reminder that whether in the lab, workspace or in your personal life, how you organize your particles (as metaphor for your tasks, energy, and priorities) makes all the difference.

[1] Mraovic J. The Pickle Jar Theory: A Smarter Way to Manage Your Time. Clockify 2025. Accessed at: https://clockify.me/blog/managing-time/pickle-jar-theory/

WHY JOIN US?

- We love to understand your technical and social experiences, especially your untold stories throughout the learning and working journey.
- We would like to motivate more students - researchers to follow their passion and careers in particle science.
- We believe a single effort and contribution to help make our world better should be recognised and spread out.

HOW?

If you are interested in participating, please contact us for more details!

C. UPDATE CORNER

C1. My Experience with RSC 'Meet the Editors'-Event

Written by Anna Anandita

Attending the RSC Meet the Editors event in Jammu (India) on 9 February 2026 was an enriching experience that offered valuable insights into current research trends, scientific publishing, and advances in materials science, particularly in batteries and particle characterisation. The event brought together researchers, students, and academics from diverse backgrounds, creating an engaging platform for knowledge exchange and networking. The session began with introductions from the Royal Society of Chemistry editors, who shared their perspectives on the evolving landscape of scientific publishing.

Key highlights

- Practical advice on communication research
- Enriching talks on various applications of particles in energy and battery technologies

Speakers discussed how advanced characterisation techniques are being used to understand battery performance, degradation mechanisms, and material stability. Discussions included the role of particle size distribution, surface morphology, and structural analysis in improving energy storage systems. These sessions highlighted how particle characterisation directly influences material optimisation, efficiency, and long-term performance in electrochemical applications.

Researchers also shared experiences using analytical techniques to study particle behaviour, flow properties, and microstructure. These exchanges demonstrated how multidisciplinary collaboration strengthens research outcomes and helps bridge the gap between fundamental science and industrial applications.

Overall, the RSC Meet the Editors event in Jammu (see relevant links below) served as an inspiring platform to learn not only about scientific publishing but also to get informed on current advancements in battery research and particle characterisation. The experience reinforced the importance of clear scientific communication and interdisciplinary collaboration. Participating in such events helps researchers stay updated to developments in their field, along with an efficient networking while building confidence to contribute to the developments of the global scientific community.

https://www.rsc.org/events/detail/83156/rsc-meet-the-editors-iit-jammu

https://www.linkedin.com/posts/royal-society-of-chemistry-editorial-meet-ugcPost-7431955915924471808-FWFY/

C2. Upcoming events of interest

UK-based events

UK and Ireland-based events starting during the next months that may interest you include:

1) CMAC Open Day 2026, 24-26 March 2026, Glasgow

https://www.cmac.ac.uk/open-days-2026

2) Past, Present and Future Particle Technology 2026, 30/3 - 1/4/2026, Leeds https://constableandsmith.com/pages/past-present-future-particle-technology-conference#register

3) Integrating chemistry, engineering and biology to create the next generation of vaccines, 30 March 2026, Cambridge https://www.rsc.org/events/detail/82380/integrating-chemistry-engineering-and-biology-to-create-the-next-generation-of-vaccines

4) Rideal Lecture and Symposium: Polymer Colloids: From Engineering to Biology, 8 April 2026, London https://www.soci.org/events/colloid-and-surface-chemistry-group/2026/rideal-lecture-and-symposium-polymer-colloids-from-engineering-to-biology

5) RSC Main Group Interest Group Annual Meeting and AGM, 8-9 April 2026, Edinburgh https://www.rsc.org/events/detail/82872/rsc-main-group-interest-group-annual-meeting-and-agm

6) Vibrations at interfaces Faraday Discussion, 8-10 April 2026, Manchester https://www.rsc.org/events/detail/80614/vibrations-at-interfaces-faraday-discussion

7) The 59th Annual International Meeting of the ESR Spectroscopy Group of the Royal Society of Chemistry, 13 April 2026, Colchester https://www.rsc.org/events/detail/82900/the-59th-annual-international-meeting-of-the-esr-spectroscopy-group-of-the-royal-society-of-chemistry

8) IEEE Magnetics Society INTERMAG 2026, 13-17 April 2026, Manchester https://intermag2026.org/

9) Bridging the gap from surface science to heterogeneous catalysis Faraday Discussion, 20-22 April 2026, London

https://www.rsc.org/events/detail/80739/bridging-the-gap-from-surface-science-to-heterogeneous-catalysis-faraday-discussion

10) The 3rd Midland Innovation Electron Microscopy (MIEM) Conference, 21 April 2026, University of Warwick

https://warwick.ac.uk/research/rtp/em/info/miem-2026/

11) Facility Day on Particle Characterisation, 23 April 2026, Leeds

https://geosolutions.leeds.ac.uk/sorby-lab/facility-day-on-particle-characterisation/

12) A beautiful twist on condensed matter (Discussion Meeting), 28-29 April 2026, London

https://royalsociety.org/science-events-and-lectures/2026/04/beautiful-twist-on-condensed-matter/

13) Inhaled Particles and International Particle Toxicology Conference, 11-14 May 2026, Glasgow

https://www.bohs.org/events-networking/events/upcoming-events/detail/inhaled-particles-and-international-particle-toxicology-conference/

14) Spin physics in 2D van der Waals materials (Theo Murphy meeting), 18-19 May 2026, Edinburgh

https://royalsociety.org/science-events-and-lectures/2026/05/spin-physics/

15) Light-driven chemistry for a sustainable future (Discussion meeting), 1-2 June 2026, London

https://royalsociety.org/science-events-and-lectures/2026/06/light-driven-chemistry/

16) SPECS Conference 2026, 2 June 2026, University of Hertfordshire

https://forms.office.com/pages/responsepage.aspx?id=ur7mk6rEMUevXdc1sJfq27ov71hVilhNkygNrG2DhU5UQUFQQTNRUkNRMjFNQTFMVlA5SVM3UVRSTy4u&route=shorturl

17) EuroMXene26 Conference, 3-5 June 2026, Dublin

https://euromxene26.com/

18) Medicinal Chemistry Summer School 2026, 7-12 June 2026, Loughborough

https://www.rsc.org/events/detail/81471/medicinal-chemistry-summer-school-2026

19) 9th Annual UKPorMat (Porous Materials) Conference, 9-10 June 2026, Bristol

https://www.ukpormat.com/

20) Powder Characterisation 2026, 9-10 June 2026, Leeds

https://constableandsmith.com/pages/powder-characterisation-2026

21) Cambridge Particle Meeting, 22 June 2026, Cambridge

https://cambridgeparticlemeeting.org/2026

22) The Annual Early Career Colloid (ECCo) meeting, 25-26 June 2026, Hertfordshire

https://colloidsgroup.org.uk/8th-annual-early-career-colloid-meeting-25-26-june-2026-hertfordshire/

23) ScotChem Polymers & Soft Materials Conference 2026, 26 June 2026, Edinburgh

https://www.eventbrite.co.uk/e/scotchem-polymers-soft-materials-conference-2026-tickets-1980455137629

24) Emerging materials for optoelectronics applications Faraday Discussion, 1-3 July 2026, Edinburgh

https://www.rsc.org/events/detail/80738/emerging-materials-for-optoelectronics-applications-faraday-discussion

25) EnvChem 2026 Chemistry of the Whole Environment, 2-3 July 2026, Coventry

https://www.rsc.org/events/detail/83006/envchem2026-chemistry-of-the-whole-environment

26) Bath EIS Summer School 2026 (Theory and Practice of Electrochemical Impedance Spectroscopy), 14-17 July 2026, Bath

https://www.bath.ac.uk/publications/2026-electrochemistry-winter-and-summer-schools-flyers/attachments/EIS-Summer-School-Flyer-2026.pdf

27) IMC21 (The 21st International Microscopy Congress), 31/8 - 4/9/2026, Liverpool

https://www.imc21.org.uk/

28) Basics of Particle Characterisation Workshop, 12 November 2026, Luton

https://www.anton-paar.com/uk-en/services-support/seminars/detail/event/basics-of-particle-characterisation-workshop/

29) Horizons Symposium 2026: (Nano)catalysis, 12-13 November 2026, London

https://www.rsc.org/events/detail/83161/horizons-symposium-2026-nano-catalysis

30) The Drug Delivery to the Lungs (DDL) conference, 9-11 December 2026, Edinburgh

https://ddl-conference.com/

31) Surface-enhanced Raman Scattering (SERS) Faraday Discussion, 14-16 April 2027, London

https://www.rsc.org/events/detail/82371/surface-enhanced-raman-scattering-faraday-discussion

Non – UK and Ireland events of possible interest

1) MATSUS Spring 2026 (Materials for Sustainable Development Conference, 23-27 March 2026, Barcelona, Spain

https://www.nanoge.org/MATSUSSpring26/home

2) International Conference on Biomaterials 2026, 9-12 April 2026, Shenzhen, China

https://www.elsevier.com/events/conferences/all/international-conference-on-biomaterial

3) Physics of Light-Matter Coupling in Nanostructures and Nanophotonics (PLMCN-2026), 12-15 April 2026, Yerevan, Armenia

https://events.mifp.eu/PLMCN-2026/

4) Thematic School on Nanometric Gold, 13-17 April 2026, Cargese, Corsica, France (mostly directed to french-speaking participants).

https://ecole2026.sciencesconf.org/?lang=fr

5) School of Nanomedicine, 20-22 April 2026, Bari, Italy

https://www.ba.ic.cnr.it/nanomedicine2026/

6) Nanoscale and Microscale Heat Transfer IX, 20-24 April, 2026, Berlin, Germany.

https://premc.org/nmht2026/

7) TERMIS-EU'26 'Accelerating multidisciplinary innovation to close the gap in clinical translation', 21-25 April 2026, Palma de Mallorca, Spain

https://eu2026.termis.org/

8) ChemBio-VIII (Biannual Meeting of the Chemical Biology Group/Spanish Royal Society of Chemistry, 27-29 April 2026, Donostia-San Sebastian, Spain

https://www.chembio2026.com/

9) International Quantum Matter Conference & Expo, 27-30 April 2026, Barcelona, Spain

https://www.quantumconf.eu/2026/index.php

10) 9th World Conference on Research Integrity, 3-6 May 2026, Vancouver, Canada

https://wcri2026.org

11) PICO2026 (9th Conference on Frontiers of Aberration Corrected Electron Microscopy), 3-7 May 2026, Kasteel Vaalsbroek, The Netherlands

https://er-c.org/index.php/conferences/pico-2026/

12) 12th International Symposium on the Characterization of Porous Solids, 4-6 May, 2026, Dresden, Germany

https://cops-xii.org/

13) Surfaces, Interfaces and Coatings Technologies International Conference, 6-8 May, 2026, Prague, Czech Republic

https://www.setcor.org/conferences/sict-2026

14) 3rd International Conference on Engineering Manufacture, 7-8 May 2026, Porto, Portugal

https://www.engeduconferences.com/EM2026/

15) The 10th World Congress on Particle Technology, 11-15 May 2026, Osaka, Japan

https://wcpt10.org/

16) The 3rd International Conference on: Environmental Design, Material Science, and Engineering Technologies (EDMSET), 12-14 May 2026, Abu Dhabi, UAE https://www.ierek.com/events/environmental-design-material-science-and-engineering-technologies-edmset-3rd-edition#conferencetopics

17) MOF2026 (the 10th International Conference on Metal-Organic Frameworks and Open Framework Compounds), 17-20 May 2026, New Orleans, Louisiana, USA

https://na.eventscloud.com/website/86715/home/

18) AMBRA 2026 (3rd International Conference on Advanced Materials for Bio-related applications), 17-21 May 2026, Warsaw, Poland

https://ambra.ippt.pan.pl/

19) Hybrid & Organic Photovoltaics, 18-20 May 2026, Uppsala, Sweden

https://www.nanoge.org/HOPV26/home

20) SoftComp/EUSMI Annual Meeting 2026 (Soft Matter Composites), 18-21 May 2026, Zakopane, Poland

https://eu-softcomp.net/news/meetings/annual-meeting-2026/

21) Microfluidic Horizons 2026, 18-22 May 2026, Padua, Italy

https://www.microfluidics2026.it/

22) Artificial Intelligence for Advanced Materials, May 19-21, 2026, Madrid, Spain

https://ai4am.net/2026/index.php

23) Manufacturing and Characterization of Sustainable Electronics (Training programme), 20-22 May 2026, Iraklio, Crete, Greece

https://infrachip.eu/research-accelerator-programme/

24) E-MRS Spring Meeting (European Materials Research Society), 25-29 May 2026, Strasbourg, France

https://www.european-mrs.com/

25) Magnetics and Optics Research International Symposium 2026 (MORIS2026), 25-28 May 2026, Nagasaki, Japan

https://moris2026.org/

26) 15th International Conference on the Scientific and Clinical Applications of Magnetic Carriers (MagMeet), 26-29 May 2026, Sorbonne University, Paris, France

https://magneticmicrosphere.com/meeting-fifteenth

27) CSI 2026 (Cluster Surface Interactions International Conference), 1-4 June 2026, Paris, France

https://csi2026.sciencesconf.org/?lang=en

28) 2nd RIANA Training School on Nanoscience & Nanotechnology (Ion beam-based techniques for structuring and characterization), 1-4 June 2026, Dresden, Germany

https://events.hifis.net/event/3575/

29) Artificial Intelligence, Neuromorphic Learning, and Quantum Technologies in Functional Materials Workshop, 1-5 June, 2026, Thessaloniki, Greece

https://cossphy.web.auth.gr/?page_id=327

30) FBNL-MR 2026 (French-Benelux Magnetic Resonance Conference), 2-5 June 2026, Lille, France

https://fbnl-mr-2026.sciencesconf.org/

31) 16th Mediterranean Congress of Chemical Engineering, 2-5 June 2026, Barcelona, Spain

https://www.mecce.org/

32) Galician Symposium on Materials for Energy Storage and Conversion, 4-5 June 2026, Vilagarcia de Arousa, Spain

https://electromolmat.com/galicia4energy/

33) 15th International Colloids Conference, 7-10 June 2026, Sitges, Spain https://www.elsevier.com/events/conferences/all/international-colloids-conference

34) 'Heat it, Blend it - The Dual Life of Magnetic Soft Matter', 8-10 June 2026, Saint-Etienne, France

https://magsoftmat.sciencesconf.org/

35) Bombannes 2026 - 17th European Summer School on 'Scattering Methods Applied to Soft Condensed Matter', 9-16 June 2026, Carcans-Maubuisson, Gironde, France

https://workshops.ill.fr/event/522/

36) IEEE Magnetics Society Summer School 2026, 14-19 June 2026, Cairo, Egypt

https://ieeemagnetics.org/membership/educational-outreach/summer-school

37) Formulation and Delivery Europe, 15-16 June 2026, Berlin, Germany https://oxfordglobal.com/discovery-development/events/discovery-development-europe/formulation-delivery-europe

38) NanoSeries 2026 (Conference on Global Nanotechnology, 5th Edition), 15-17 June 2026, Turin, Italy

https://nanoseriesiac.com/

39) 30th Annual Green Chemistry & Engineering Conference, 15-18 June 2026, San Antonio, Texas, USA

https://www.gcande.org/

40) EPoSS Annual Forum 2026 (European Association on Smart Systems Integration), 16-19 June 2026, Braga, Portugal

https://www.smart-systems-integration.org/event/eposs-annual-forum-2026/

41) Nanotech France - The International Nanotech & Nanoscience Conference & Exhibition, 17-19 June 2026, Paris, France

https://setcor.org/conferences/nanotech-france-2026

42) 100th American Chemical Society Colloid and Surface Science Symposium, 21-24 June 2026, University of Delaware campus, USA

https://sites.udel.edu/colloids2026/

43) The European Conference on Physics of Magnetism 2026 (PM'26), 22-26 June 2026, Poznan, Poland

https://www.ifmpan.poznan.pl/pm26

44) Summer School on 'Bio-inspired molecules and materials for medicinal applications 22/6 - 1/7/2026, Democritus University of Thrace, Kavala, Greece

https://bio3ms.kedivim.duth.gr/

45) Grenoble Workshop on Nanomagnetism (GWN 2026), 23-26 June 2026, Grenoble, France

https://gwn2026.sciencesconf.org/

46) ECS11 (11th European Crystallography School), 28/6 - 4/7/2026, Stockholm, Sweden

https://www.ecs11.org/

47) SusChemE-SUSTENS2 (Sustainable Chemical Engineering Systems), 29-30 June 2026, Athens, Greece

https://www.suscheme-sustens2.com/

48) 20th European Student Colloid Conference, 29/6 - 2/7/2026, Donostia-San Sebastian, Spain

https://esc2026.cfm.ehu.es/

49) Graphene 2026, 30/6 - 3/7/2026, Barcelona, Spain

https://www.grapheneconf.com/2026/index.php

50) Nanotexnology 2026 - International Conference & Exhibition on Nanotechnologies, Organic Electronics & Nanomedicine, 4-11 July 2026, Thessaloniki, Greece

https://www.nanotexnology.com

51) Colloidal Semiconductor Nanocrystals, Gordon Research Conference - Unlocking the Future of Nanocrystal Chemistry for Light, Energy and Technology, 5-10 July 2026, Les Diablerets, Vaud, Switzerland

https://www.grc.org/colloidal-semiconductor-nanocrystals-conference/2026/

52) EMSA 2026 - The XV European Magnetic Sensors and Actuators Conference, 6-9 July 2026, Eindhoven, the Netherlands

https://emsa2026.dryfta.com/index.php

53) 17th International Conference on Surfaces, Coatings and Nanostructured Materials' (NANOSMAT2026), 6-10 July 2026, Rhodes, Greece

https://nanosmat.org/

54) Liplii2026: Light Interaction with Particles / Laser Induced Incandescence, 6-10 July 2026, Rouen, France

https://liplii2026.sciencesconf.org/

55) 8th International Conference on Nanomaterials Science and Mechanical Engineering, University of Aveiro, Portugal, 7-10 July 2026 (ICNMSME-2026)

https://icnmsme.web.ua.pt/

56) 10th EuChemS Chemistry Congress, 12-16 July 2026, Antwerp, Belgium

https://euchems2026.eu/

57) FEMS Junior Euromat 2026, 12-16 July 2026, Trikala, Greece

https://junioreuromat2026.com/

58) 7th International Caparica Conference on Chromogenic and Emissive Materials, 12-16 July 2026, Caparica (Lisbon area), Portugal

https://ic3em2026.com

59) International Workshop on Ferroelectric Nitrides (IWFN), 16-17 July 2026, Ann Arbor, Michigan, USA

https://icmbe2026.eecs.umich.edu/iwfn

60) Doctoral Conference in Energy, Technologies and Industrial Processes 2026, 21-22 July 2026, Vigo, Spain

https://dcetip26.es/

61) The 48th PIERS (Progress in Electromagnetics Research Symposium), 27-31 July 2026, Suzhou, China

https://suzhou2026.piers.org/

62) Materials, Methods & Technologies - 28th International Conference, 13-16 August 2026, Burgas, Bulgaria

https://www.sciencebg.net/en/conferences/materials-methods-and-technologies/

63) Samarkand International Symposium on Magnetism, 17-23 August 2026, Samarkand, Uzbekistan

https://sism.samdu.uz/

64) ACS Fall 2026, 23-27 August 2026, Chicago, USA

https://www.acs.org/events/fall.html

65) 21st International Conference on Defects Recognition, Imaging and Physics in Semiconductors, 30/8 - 3/9/2026, Warsaw, Poland

https://drip21.pl/

66) 40th Conference of the European Colloid & Interface Society, 6-11 September 2026, Granada, Spain

https://eventos.ugr.es/ecis2026/

67) 35th Annual Conference of the European Society of Biomaterials, 7-11 September 2026, Antwerp, Belgium

https://fems.org/35th-annual-conference-of-the-european-society-of-biomaterials-esb-2026/

68) Flatlands beyond graphene (Conference on 2D materials), 7-11 September 2026, Dresden, Germany

https://events.hifis.net/event/3442/

69) 4th Conference on Electron Microscopy of Nanostructures (ELMINA2026), 7-11 September 2026, Belgrade, Serbia

https://www.elmina.rs

70) EMRS Fall Meeting & Exhibit (European Materials Research Society), 14-17 September 2026, Warsaw, Poland

https://www.european-mrs.com/meetings/2026-fall-meeting-exhibit

71) 7th International Energy Storage Materials Conference, 20-23 September 2026, Dresden, Germany

https://www.elsevier.com/events/conferences/all/energy-storage-materials-conference

72) MNE 2026 - 52nd Micro + Nano Engineering Conference, 21-24 September 2026, Interlaken, Switzerland

https://mne2026.imnes.org/

73) Graphene Week 2026 (Graphene Flagship), 21-25 September 2026, Porto, Portugal

https://graphene-flagship.eu/events/graphene-week-2026

74) MSE 2026 (International Materials Science and Engineering Congress), 29/09 - 01/10/2026, Darmstadt, Germany & Online (hybrid)

https://mse-congress.com/

75) NANOCON'26 - 18th International Conference on Nanomaterials - Research & Application, 30/9 - 2/10/2026, Brno, Czech Republic

https://www.nanocon.eu/en/

76) NanoSpain Conference 2026, 5-8 October 2026, Tarragona, Spain

https://www.nanospainconf.org/2026/index.php

77) SPICA 2026 (20th International Symposium on Preparative and Industrial Chromatography and Allied Techniques, 13-16 October 2026, Muttenz (Basel), Switzerland

https://www.spica2026.org/

78) MicroTAS 2026, 30th International Conference on Miniaturized Systems for Chemistry and Life Sciences, 18-22 October 2026 Granada, Spain

https://microtas2026.org/

79) C-Horizon (Carbon Science and Technology Conference), 26-28 October 2026, Paris, France

https://carbonscitech.com/

80) MATSUS26 Fall - Materials for Sustainable Development Conference, 26-30 October 2026, Mallorca, Spain

https://www.nanoge.org/MATSUSFall26/home

81) JMC 2026 (Journees de la Matiere Condensee - Condensed Matter Physics Conference), 26-30 October 2026, Toulouse, France

https://www.nanoge.org/MATSUSFall26/home

82) MMM'2026 - 71st Annual Conference on Magnetism and Magnetic Materials, 2-6 November 2026, Honolulu, Hawaii, USA

https://ieeemagnetics.org/event/conference/71st-annual-conference-magnetism-and-magnetic-materials

83) RESCON Europe 2026, 10-11 November 2026, Porto, Portugal

https://rescon-europe.com/about/

84) 1st Global MXene and 2D Materials Conference 2026 (GMXC2026), 11-14 November 2026, Suwon, South Korea

https://gmxc2026.com/index.php?GP=int/wm

85) 6th International Conference on Emerging Advanced Nanomaterials, 16 November 2026, Newcastle, Australia

https://www.rsc.org/events/detail/83095/6th-international-conference-on-emerging-advanced-nanomaterials

86) NanoBio&Med2026 conference, 1-3 December 2026, Barcelona, Spain

https://www.nanobiomedconf.com/NBM26/index.php

87) Magnonics 2027 - 10th international conference on fundamentals and applications of magnons, 2-6 August 2027, Vienna, Austria

https://magnonics2027.univie.ac.at/

88) European Polymer Congress 2027 (EPF2027), 5-9 July 2027, Riga, Latvia

https://epf2027.org/

89) JEMS 2027 - Joint European Magnetic Symposia, 29/08 - 03/09/2027, Prague, Czech Republic

https://www.jems2027.eu

90) FEMS EUROMAT'27 - 19th European Congress and Exhibition on Advanced Materials and Processes, 12-16 September 2027, Graz, Austria

https://euromat2027.com/

The PCIG is always happy to hear about up-and-coming events that our members are interested in. If you have any suggestions for events to be included in our newsletters, please contact us and we will include these in our next edition.

CONTACT US

Visit our own website for further information: https://pcig.co.uk/ or go to our official RSC-website:

https://www.rsc.org/membership-and-community/connect-with-others/through-interests/interest-groups/particle-characterisation/

Do you have any questions, feedback or are you willing to contribute as a collaborative writer? Please email the RSC-PCIG Particle Newsletter Team via: **Particlenewsletter@gmail.com** and we will get back to you.