Newsletter 2 (PCIG N2) - 26.08.2023

Welcome to the second edition of our newsletter!Welcome to the second

edition (May – August 2023) consists of three main sections:

A. Research highlights, which represents the emerging technologies in particle characterisation.

, which reveals the motivation and sharing from different researcher members.

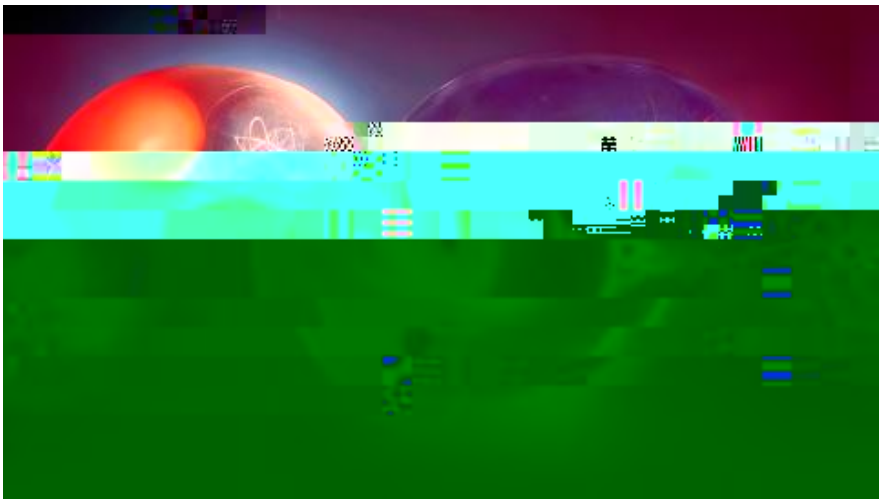
, which summarises the new events, collaboration, and other opportunities.

Our current edition team includes **Tien Thuy Quach, Merel Bout, and Mel Disher**. We would like to express great appreciation to **the PCIG Committee** for encouraging and advising us to issue the second edition of PCIG Newsletter. Many thanks for the contribution from the people

A. RESEARCH HIGHLIGHTS

Elemental particles: our building blocks

Written by Merel Bout



Portrayal of a particle with their subatomic building blocks (electron, proton, neutron and quarks and leptons) (Image Credit: Rick / Adobe Stock)

In our second newsletter's exploration of particle characterization, we delve into the fundamental building blocks of matter and in particular particles. Particles are composed of atoms, but even atoms are made up of smaller components. For a long time, it was believed that the smallest components were protons, neutrons and electrons. However, half a century ago in 1964 (just two years before the PCIG was founded!) even smaller building blocks were found within protons and neutrons: these particles were named quarks. Below a short overview of these (sub)atomic building blocks that make up the bigger particles that are typically of interest to particle characterisation.

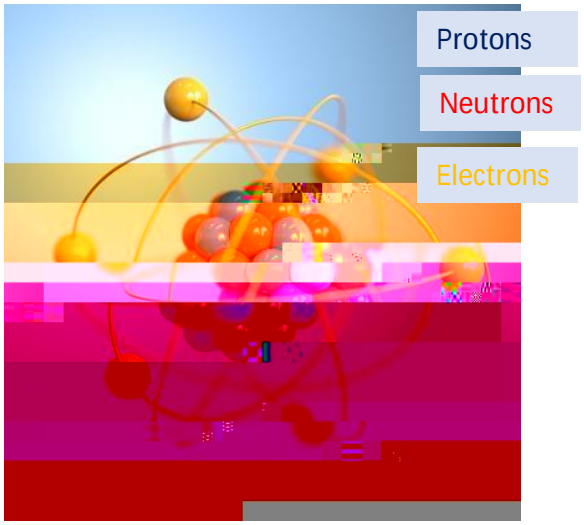
Neutrons: The Silent Stabilizers of Atomic Nuclei

At the heart of every atom lies the nucleus, composed of neutrons and protons. Neutrons, as their name suggests, are electrically neutral particles. Alongside protons, they form the backbone of atomic stability. While protons carry a positive charge, the neutral nature of neutrons helps counteract the electrostatic repulsion between protons, maintaining the integrity of the atomic nucleus. Neutrons play a crucial role in defining the isotopes of an element, as variations in the number of neutrons give rise to different atomic masses.

Protons: The Positive Powerhouses

Protons, in contrast to neutrons, carry a positive electrical charge. They are essential in determining the atomic number of an element, which defines its unique chemical properties. The number of protons in the nucleus dictates an element's position in the periodic table and

its fundamental characteristics. The remarkable stability of atomic nuclei, despite the mutual repulsion between protons, is a result of the intricate balance between attractive nuclear forces and electromagnetic repulsion.



Simplified map from Physics for the 21st Century, The Basic Building Blocks of Matter (Image Credit: koya79/ Getty Images)

Electrons: The Fundamental Charge Carriers

At the heart of matter lies the electron, an elementary particle with a negative electric charge. Electrons are found orbiting the nucleus of atoms and play a crucial role in electricity, magnetism, and chemical bonding. With a mass approximately 1/1836 times that of a proton,

(2) https://bigthink.com/hard-science/quarks-leptons-smallest-particles/
(3) https://www.livescience.com/37206-atom-definition.html
(4) https://www.learner.org/wp-content/uploads/2018/12/physics-for-21st-century-basic-building

Equally, a coating often comprises a slurry of powder in liquid that is sprayed or dipped onto a substrate before consolidating with heat or UV light. At the very least then, powder suspensions (as well as the dry powder starting material) should be monitored for particle size. Agglomeration in the dry powder state is overcome in suspension, especially if surfactants are used. Powder suspensions also open up additional characterisation techniques that are vital for QC and product development purposes. Returning to spray drying, the rheology and surface tension of a powder suspension will play a key role in defining how well it is pumped to the nozzle and how it breaks up into droplets during atomization. The rheology (in aqueous systems) will in turn be influenced by zeta potential (the surface charge a powder assumes in water) as this controls flocculation vs deflocculation.

When smaller amounts of liquid are present in powder suspensions, we encounter the field of pastes capable of being extruded into shaped products. Should the use of capillary rheometer to characterise pastes be included under the theme of powder characterisation?

Taking deliberations further the next question could be “What is a particle suspension”? Is it only a solid powder particle in a liquid or could / should the analysis of liquid droplets in liquids (emulsions) or bubbles in water be considered a particle suspension? Past events organised by PCIG have attempted to embrace all three scenarios.

It is clear then that powder characterisation is a very broad field, covering techniques that are immediately associated with powder testing as well as other perhaps more peripheral offerings. Ultimately it is important that researchers and industrialists are aware of the widest range of analytical techniques possible, pulling together the most relevant ones on a case-by-case basis. Therefore, as well as providing awareness of different analytical techniques, an important aim for PCIG is to share case studies on how a suite of analytical techniques were chosen to help develop a new product or maximise yields in an existing product.

Measuring the right properties in powders and powder suspensions allows a thorough exploration of material/processing variables and how this impact final product quality further down the line. Taking an example from my own experience, cements used in a medical setting sometimes experience syneresis: this is where, over time, the liquid and powder phases become separated despite appearing to be well blended at time zero. Conventional plate-on-plate rheometry (see image below) generating shear stress vs shear rate profiles was unable to d

Plate on Plate Rheometer *Hammer Mill*

However, turning to oscillatory rheometer (and using centrifugally induced sedimentation analysis for correlation studies) proved successful. Having identified a sound analytical technique to quantify end product behaviour, the next logical step is to employ Design of Experiment (DoE) software to explore the impact of both materials variables (e.g. wt% powder, powder PSD and liquid phase viscosity) and processing variables (such as rotator geometry and rotator speed associated with Hammer Milling -

B. PEOPLE FOCUS

Get to know

We can understand the research interest and career pathways from our PCIG members. We will start with an overview of two of the Committee members, but please contact us to share your background and experience in future newsletters.

Chris Williamson BA, FRSC

"I have over 40 years of in-depth technical and professional experience acquired from extensive periods in drug discovery, development projects and outsourcing programmes (exclusively within GlaxoSmithKline) and as an independent consultant.

My chemistry degree was from York in 1973 and I went straight to work as an organic chemist at Glaxo, Greenford. In Medicinal Chemistry I discovered hundreds of new compounds for which the biological purpose hasn't yet been discovered (that's to say they were useless in the specific tests they were made for but who knows what awaits random screening!).

One particularly amazing new compound I made was a steroid thio-acid which led to fluticasone (Advair/Seretide) which has helped millions with their asthma (not bad for an experiment which went wrong – I was trying to make an amide!). In Chem Dev I had the privilege to lead the team which provided all the clinical trial material for zanamivir (Relenza) and we developed the commercial manufacturing process. In Manufacturing I led the technical team responsible for a diverse range of API source and supply chain changes into

a member of the RSC Networks Committee and RSC Member Communities Board. I was honoured to receive an Exceptional Service Award in 2021 as part of the volunteer network. My scientific interest in particle characterisation stems from numerous conversations in project teams where our downstream colleagues asked us to “make it the same”, without either party being really clear on what were the essential characteristic/s of the material which made it suitable or not.

I've not been an active member, or really even an active follower, of the Particle Characterisation Interest Group since I ticked the box for one of three free groups as part of my annual membership. It was simply the e-mail of 4 August from the Networks Team calling for a new chair and four new committee members which piqued my interest. I've just completed 12 years on another RSC committee and now have time to devote to an area of science which in my opinion still has room for further knowledge and understanding.

Phil Jackson

³6XEVHTXHQWO\ P\ ZRUN EURDGHQHG WR RWKHU FHUDPLF VX *sectors with a focus on powder characterization and control. I was instrumental in initiating, writing and then managing 30+ public funded projects (both UK Government and EU funded, the later under Framework IV,* 9 9, ´

I have a degree in Chemistry and a PhD in thermodynamics (1983 and 1988 respectively, from University of Leicester). Since 1986 I have worked for Lucideon Limited (formerly British Ceramic Research Limited; Ceram Research). Initially I was involved in R&D projects relating to novel Ceramic Whiteware glazing and decoration.

I played a key role in developing unleaded glaze formulations in the late 1980s / early 1990s as legislation initiated in the US threatened to ban the use of lead in glazes. As the UK ceramic industry declined, the company reinvented itself as providing general materials testing and consultancy support. In line with this change, I have largely worked in consultancy, leading a team supporting the healthcare and consumer product sectors. projects deal with optimisation of existing products, development of novel analytical approaches to test / differentiate products

Particle Characterisation Interest Group
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