Battery electrode slurries under flow

A new method for high shear rate and relaxation rheology.

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1 - We need better batteries
To meet rising demand for advanced batteries in the UK’s sustainable energy shift, the automotive sector requires:
- Fast Charging Batteries - to reduce vehicle charging times.
- High Power Batteries - to produce faster vehicles.
- High Energy Density Batteries - to extend vehicle travel range.

3D printing can meet these demands with smarter electrode structures. [1]

However, shear thinning, and relaxation are 2 behaviors of electrode slurries that can affect this process and thus need investigating.

The current metrology technique has limitations.

Thus, this research aimed to investigate a new metrology technique to extract high shear rate data from flowing anode electrode slurries.

2 - Conventional vs new electrode structure

Factors affecting 3D Printing
There are 2 rheological behaviors of slurries that can affect the ability to produce gaps during 3D printing.

Shear thinning
Low shear rates = higher viscosity = defined structure
High shear rates = lower viscosity = spreading

Relaxation
Shear inside nozzle
No shear outside nozzle
Slurry relaxes

We need to understand the effect of high shear rate on viscosity and relaxation as this can affect gap formation.

3 - Factors affecting 3D Printing

Conclusions
3D printing enhances performance with discontinuous slurry coatings.
A capillary rheometer can be used for suitability assessments by subjecting systems to shear rates of 250,000 s⁻¹, similar to 3D printing conditions.
Using the data, binder systems for 3D printed slurries can be compared.

8 - Next steps
- Obtain higher shear rate data.
- Compare slurries and optimize 3D printing.
- Add microscopy for further relaxation studies.
- Apply high shear data to the current slot die coating method.

9 - References

Intern bio
Shelly Tchoutezo is studying Mechanical Engineering and Materials Science at the University of Birmingham. She is interested in new methods of storing energy that will pave the way for a net zero future. After graduating, she is hoping to go into the energy sector.