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Study of the microstructure of carbon fiber monofilaments at the Australian Synchrotron SAXS/WAXS beamline

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A new SAXS-WAXS methodology has been developed at the Australian Synchrotron for the structural analysis of carbon fibres. The new technique –referred to as serial SAXS-WAXS fibre scattering is used to map the microstructural properties of single carbon fibres, ranging in diameter from 5 to 8 μm. The new SAXS/WAXS beamline end station upgrade has made feasible to measure single carbon fibre monofilaments thanks to the high incident flux and extremely low background provided by a new high-vacuum sample environment. Based on an automated scanning protocol, a single carbon fibre is aligned relative to the incident X-ray beam (beam size H: 250 μm × V: 25 μm). The fibre is mounted in vacuum while points on each monofilament are acquired. This scanning protocol ensures that the fibre scattering cross-section in known precisely. The size of the detector allows both a SAXS and WAXS signal to be recorded in a single image. Furthermore, it is now possible to increase the sample-to-detector distance automatically, making low q-SAXS practical on these samples for the first time, and without having to remount or interfere with sample condition. The technique allows both the size and alignment of the microstructural features from fibre-to fibre to be quantified. Importantly, the graphitic alignment, spacing and apparent crystallite size can be directly related to macroscopic mechanical properties. While quantitative analysis of the SAXS scattering signal from pores trapped within the fibre provides an indication of macroscopic strength. Results are presented for carbon fibres prepared on the Carbon Nexus facility at Deakin University.

Speakers Gender

Male

Travel Funding

No

Level of Expertise

Early Career <5 Years since PdD

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No

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