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X-ray computed tomography of polymer composites

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Abstract

The use of X-ray computed tomography (CT), exploiting both synchrotron and laboratory sources, has grown significantly over the last decade, driven primarily by improvements in spatial resolution, reduction in acquisition time and the increasing availability of laboratory CT systems. It is now able to provide highly accurate three-dimensional (3D) inspections of fibre architectures, manufacturing defects and in-service damage accumulation non-destructively, allowing the user to examine cross-sections that would previously have required laborious and skilled mechanical sectioning with the potential for inducing damage or loss of material. Further, by repeated acquisition of 3D images, it has opened new opportunities for time-lapse studies. This feature article reviews the technical aspects relating to the X-ray CT imaging of composites such as obtaining sufficient contrast, examination of thin panels, sample size/resolution issues, quantification and image-based modelling. The capability of X-ray CT to provide important information is considered across applications ranging from manufacturing processes, through tensile and compression loading to fatigue and impact damage. The complementary advantages of laboratory and synchrotron X-ray CT are examined with a view to identifying new opportunities and challenges.