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Investigation of nuclear reactor materials using modern electron microscopy techniques

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Abstract content
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Electron microscopy is an essential characterization and research tool for nuclear materials science, which includes materials used for the nuclear power plant, fuel cycle and waste immobilization. The research investigations carried out in the Centre for HRTEM focuses on fission product transport in silicon carbide (SiC), the joining of SiC, radiation damage in SiC, zirconium nitride (ZrN), zirconium titanium nitride (ZrTiN) and Oxide Dispersion Strengthened steel. The structural properties and radiation resistance of nanocrystalline ZrTiN coatings on zircaloy are being investigated as part of an international accident tolerant LWR fuel cladding programme.

The experimental techniques used for the materials research include scanning electron microscopy (SEM), energy dispersive x-ray spectrometry, electron backscatter diffraction, transmission Kikuchi diffraction, focused ion beam SEM, high resolution transmission electron microscopy (TEM) and electron energy loss spectroscopy.

The modern ion mills and focused ion beam used for TEM specimen preparation have created the enabling technology for the preparation of excellent TEM specimens of materials that presented serious challenges in the past. Site specific TEM specimens from soft to ultra-hard materials as well as TEM specimens from ceramic and other nano-size powders can now be prepared employing these fast and reliable methods. The application of these techniques to the characterization of the materials mentioned above will be discussed and a number of important results on metallic fission product transport in silicon carbide will be presented.

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