Ion beam analysis of materials for radiation environments

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This contribution highlights the application of advanced ion beam analysis (IBA) techniques in the development and qualification of structural materials for future nuclear systems. Techniques such as Time-of-Flight Elastic Recoil Detection Analysis (ToF-ERDA) and Rutherford Backscattering Spectrometry (RBS) enable high-resolution compositional depth profiling and are essential tools for investigating oxidation behaviour, material-coolant interactions, protective coatings, irradiation effects, impurities, and light element content (e.g., H, He, C).

At MTF STU, a state-of-the-art ToF-ERDA spectrometer provides detailed elemental composition data in a single measurement, covering elements from hydrogen to uranium. A key advantage of ToF-ERDA lies in its exceptional sensitivity to light elements and its ability to quantify trace levels of hydrogen and helium.

With the capability to resolve surface layers as thin as 10–20 nm and achieve depth resolutions below 10 nm, IBA techniques are particularly powerful for studying the early stages of corrosion and oxidation, as well as characterizing complex multilayer systems. These insights are critical for understanding degradation mechanisms and improving material performance in extreme radiation environments.

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