PAUL SCHERRER INSTITUT

LNM Seminar

18 October 2016, 15.30 h OHSA/E13

INVESTIGATION OF THE THERMAL CONDUCTIVITY OF SIC/SIC CLADDING BEFORE AND AFTER IRRADIATION

Loic Fave

Advanced Nuclear Materials (ANM), Laboratory for Nuclear Materials (LNM), NES, Paul Scherrer Institut

Silicon carbide based composites are candidates for structural components and fuel claddings in nuclear power plants. In the frame of accident tolerant fuel research, the effective through-thickness thermal conductivity of SiC/SiC prototype claddings has been investigated with a radial heat flow apparatus. Conductivities ranging between 0.5 and 4 $\mathrm{W \cdot m^{-1} \cdot K^{-1}}$ have been measured, well below the literature values of 8 to 15 $\mathrm{W \cdot m^{-1} \cdot K^{-1}}$. These differences are explained by several factors. The experimental method is able to separate the components of the thermal conductivity, parallel, and perpendicular to the fibre weave. Additionally, the complex multi-layered architectures of the tubes are detrimental, acting as barriers against heat transport.

In parallel to these activities, a specific component of SiC/SiC, the pyrolytic carbon interphase, has been investigated using analytical electron microscopy. It has been shown that this layer, linking the fibres to the matrix, becomes partially amorphous after irradiation. In-situ ion irradiations evidenced radiation-induced dimensional changes of the said layer, the impact of which would mostly be on the mechanical properties of the composite, but also on the thermal conductivity. In their current state, SiC/SiC clads seem not to have a thermal conductivity high enough to be used in power plants. A thermal conductivity locally as low as 1 $\mathrm{W \cdot m^{-1} \cdot K^{-1}}$ results in fuel temperatures high enough for UO_2 to reach its melting point.