Uranium Diboride, Accident Tolerant Fuel Concepts

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Uranium diboride offers several advantages over other currently proposed Accident Tolerant Fuel (ATF) concepts. It has a high uranium density, good hydrothermal corrosion resistance and is predicted to have excellent thermal conductivity. However, due to the need to utilize enriched boron-11 within its manufacture it is often overlooked. The recent resurgence of high-density fuel materials, particularly uranium silicide and nitride, make a reexamination of boride fuels particularly interesting.

Within the present work we will discuss the potential for UB_2 fuel pellets to work within a light water reactor environment, as well as work on U_3Si_2 composite material, which greatly improves the latters hydrothermal corrosion performance. We will present microstructural, thermal and corrosion data on UB_2 material and composite fuel pellets, and suggest that the degradation mechanism of U_3Si_2 in steam can be more fully understood by comparing observations for U_3Si_2 and UB_2/U_3Si_2 composites. In particular, the observation of hydride striations on composite material exposed to steam, currently thought to be a key mechanism for the rapid and energetic U_3Si_2-steam reaction, suggests that this is not the only important reaction taking place, as these composites react in a much more measured fashion. It appears that the redistribution of silicon within the material during surface oxidation also plays an important role in the rapid corrosion of U_3Si_2.