The influence of Mo content on the microstructural evolution of irradiated U-Mo fuels

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Uranium-molybdenum (U-Mo) fuels are being investigated as low enriched uranium (LEU) alternatives to high enriched uranium (HEU) fuels currently used in high-performance research reactors. One of the main causes of failure in U-Mo is the accumulation, interconnection of fission gas bubbles resulting in fission gas release. The release of these fission gases accelerates swelling behavior and subsequent fuel failure. Previously, it was suggested that Mo content between 7 and 10 weight percent (wt.%) would swell the least and that U-7wt% Mo has the most promising irradiation behavior. In this contribution, we investigate the influence of Mo (7 vs. 10wt.%) content and temperature on the microstructural evolution of irradiated U-Mo fuels as a function of increasing fission density. This work reports the microstructural changes occurring in U-7wt%Mo and U-10wt%Mo fuel specimens, including fuel matrix interaction layer and porosity evolution. The onset of fission gas pore interconnection was not observed in this study at a mean porosity 28% in U-10Mo. Higher Si content in the Al matrix promotes diffusion towards the fuel particles, suppressing the interaction between U-Mo and the Al in the matrix. The Si content in the Al matrix was 4 times higher in the U-7Mo specimen. This was sufficient to result in a uniform growth of the FMI layer at high fission densities. Additionally, a higher fraction of non-recrystallized grains was observed in U-10Mo, this suggests that the superlattice decomposition and thus grain subdivision occurs at a slower rate.