



Contribution ID: 77

Type: Oral

## Migration behavior of silver in SiO<sub>2</sub>-SiC double layer

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In nuclear fuels, thin film diffusion barriers are necessary to prevent the release of radioactive waste products. The combination of chemically stable silicon carbide (SiC) and silicon oxide (SiO<sub>2</sub>) layers was considered to be beneficial in preventing the release of silver from TRISO particle fuel, at normal reactor operating temperatures (between 800 and 1000 °C). However, it is important to investigate the efficiency of the SiO<sub>2</sub>-SiC double layer at higher temperatures, similar to temperatures under accident conditions. In this study, 300 keV silver (Ag) ions were implanted into polycrystalline SiC to a fluence of  $1 \times 10^{16}$  ions/cm<sup>2</sup> in vacuum at room temperature and 600 °C. The as-implanted SiC samples were coated with SiO<sub>2</sub> layers to a thickness of about 100 nm, using DC magnetron sputtering. After SiO<sub>2</sub> deposition, the samples were subjected to sequential isochronal annealing at temperatures ranging from 1100 to 1400 °C in steps of 100 °C for 5 hours, using a vacuum tube furnace. The thickness of the SiO<sub>2</sub> layers before and after annealing as well as the migration behavior of Ag in the SiO<sub>2</sub>-SiC double layer were investigated using Rutherford backscattering spectrometry (RBS) and annular bright-field scanning transmission electron microscopy (ABF-STEM). Our investigations show no diffusion of Ag in SiC after annealing at 1100, 1200 and 1300 °C. However, annealing at temperatures from 1100 to 1300 °C caused partial sublimation of SiO<sub>2</sub> layer and thermal etching of SiC surface. Moreover, RBS results showed that annealing at 1400 °C resulted in the complete sublimation of SiO<sub>2</sub> layer from the surface of SiC, while thermal etching of SiC caused a shift in the Ag depth profile towards the surface. This indicates that SiO<sub>2</sub> is not suitable for use as an additional diffusion barrier for SiC where temperatures in a nuclear reactor can reach 1600 °C during accident conditions.

### Notes

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