Objective

Next generation nuclear fuels will consist of a layered sphere that contains a fissile material at its core surrounded by coatings serving various purposes. During the fusion process, nearly every element is produced to some degree. The diffusion barrier is designed to contain these products. In previous designs, SiC was used as a diffusion barrier. During reactor tests, Cs was found to escape the fuel. ZrC was proposed to replace SiC due to its strength and stability at high temperatures. Palladium is of great interest due to its catalytic properties. This study will use X-ray Photoelectron Spectroscopy to monitor the chemical environment of Pd and ZrC as a function of Pd growth and temperature (32-1200°C).

Equipment

- High dynamic range Electron Analyzer ⇒ XPS, XAES, UPS
- X-ray Source ⇒ XPS, XAES
- UV-Source ⇒ UPS
- Ar+ Gun ⇒ IPES
- IPES detector ⇒ IPES
- Scanning Probe Microscope ⇒ AFM, STM, STS, KPFM
- Glove Box ⇒ clean sample entry
- High resolution Electron Analyzer ⇒ XPS, XAES, UPS
- Monochromatized X-ray Source ⇒ XPS, XAES
- Monochromatized UV-Source ⇒ UPS

The growth pattern of Pd on ZrC

After the deposition of Pd thin film on ZrC, the sample was heated for 100°C steps from 600°C to 963°C. Between heating steps, the sample was allowed to cool to ≈200°C for measurement.

Results/Future Work

The Pd peak shifts to higher binding energies during growth on ZrC. A shift to higher binding energies is present when heated. There is also a decrease in intensity of the Pd peaks when heated. The shift and decrease in intensity can be explained by diffusion into the bulk which could destabilize the ZrC layer of the TRISO fuel particle. The changes could also be explained by the evaporation of Pd off the ZrC surface.

Further investigation of the Pd chemical environment is necessary. Imaging of the ZrC surface is planned to further explain the growth pattern of Pd. Imaging will also be used to aid in the understanding of the Pd chemical shift during growth and heating. If Pd is defusing into the bulk of ZrC, holes will be seen in the microscopy images.

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