Cr–Al composite cladding prepared by swaging and electroplating

Hyeong Woo Min, Jaehwan Ko, Yong Hee Kim and Young Soo Yoon

Materials Science & Engineering, Gachon University
Department of Nuclear Engineering, Korea Advanced Institute of Science and Technology (KAIST)
E-mail: benedicto@gachon.ac.kr

Abstract

- Zircaloy-4 has good mechanical and chemical properties. However, they are found poor properties at high temperature and pressure.
- ATF (accident tolerant fuel) cladding development research is actively to overcome high temperature and high temperature.
- Cr plated Al is stable material at high temperature. ATF clad tube was fabricated by swaging the Cr-plated Al tube on the outside Zircaloy-4.
- SEM-EDX analysis observed gap between Cr plated Al and Zircaloy-4.
- Heat treatment analysis determined the degree of oxidation due to changes in mass by temperature.

Experimental

- Electroplating process
- Preparation swaging process
- Swaging process

Results

- SEM (Scanning Electron Microscope)
- Heat treatment

Fig. 4. SEM image of Cr plating layer after swaging Cr plated Al / Zircaloy-4.

Fig. 5. Appearance of single Zircaloy-4, Al / Zircaloy-4 and Cr plated Al / Zircaloy-4 after 600, 900 and 1200 ℃ heat treatment.

Fig. 6. Weight increase graph of single Zircaloy-4 and Cr plated Al / Zircaloy-4 after heat treatment.

Conclusions

- In this study, a double cladding tube composed of ATF exterior and Zircaloy-4 inner tube was fabricated at room temperature.
- Cr was plated on Al exterior suitable for mass production easily, and Zircaloy-4 of the size used in commercial reactor was used for inner tube.
- Post-axial ATF cladding was physically attached to the surface of Zircaloy-4 by a swaging technology, and the shape was like a single tube without peeling off at the interface between two dissimilar metals.

References

- J. Garmack, F. Goldner, Overview of the US DOE Accident Tolerant Fuel Development Program, Idaho National Laboratory/ Idaho Falls, ID, USA, 2013