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# Corrosion Resistance of TiZrN Coatings on ZIRLO Exposed to High-Temperature Oxygen

*Thursday, 11 July 2019 15:00 (2 hours)*

The focus of this study is to determine the suitability of TiZrN coatings as a means to enhance the oxidation resistance of zirconium-alloy fuel claddings for light water nuclear reactors. The TiZrN coatings were deposited onto flattened ZIRLO tube-sections with a cathodic arc vapour deposition technique. The characterisation was performed using scanning electron microscopy (SEM) and transmission electron microscopy (TEM) techniques in conjunction with energy dispersive X-ray spectroscopy (EDS). The coatings have a thickness of ˜3.8 µm and exhibited a single-phase solid solution of Ti0.42Zr0.58N with a NaCl-type crystal structure and columnar nanocrystals. On exposure to air for 0.5 h, the coatings were effective in the protection of ZIRLO against corrosion from 300 to 600 ℃. At 700 to 900 ℃, the TiZrN coatings oxidise completely and severe oxidation of the ZIRLO beneath was observed. The coatings provided no protection at temperatures above 600 ℃ and accelerated the oxidation rate of ZIRLO. The oxidation behaviour of the coatings was also investigated at 500 ℃ in oxygen for 24 h. The results indicate that the oxidation rate of TiZrN coatings is much higher than that of the uncoated ZIRLO and the degree depended on the microstructure of the formed oxide layers. The TiZr – oxide on the coating surface is characterised by a porous microstructure which is associated with a higher oxidation rate exponent. The coatings provided protection for ZIRLO against corrosion for 20 h as oxidation of the underlying ZIRLO was not observed. The coatings acted as a barrier to block penetration of oxygen ions into the ZIRLO beneath. The premature failure of coatings which occurred after 24 h was accompanied by severe oxidation of the underlying ZIRLO.

## Apply to be<br> considered for a student <br>   award (Yes / No)?

Yes

## Level for award<br> (Hons, MSc, <br>   PhD, N/A)?

MSc

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