

# CONVERSION COATINGS TO PROTECT SPENT NUCLEAR FUEL DURING EXTENDED WET STORAGE

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## KEYWORDS

Conversion coating, boehmite, hydrotalcite, corrosion protection, Al-clad nuclear fuel.

## INTRODUCTION

A very large number of aluminium-clad spent nuclear fuels are stored in light water filled pools around the world. Most of the storage facilities have water quality management programs, to prevent and/or reduce corrosion of the fuel cladding. Pitting corrosion of the cladding could lead to exposure of radioactive fuel and contamination of storage facilities with fission products. Maintenance of water parameters within specified limits does not prevent pitting of the fuel cladding, due to synergism in the effects of certain water parameters on corrosion of aluminum alloys. Protection of spent Al-clad nuclear fuel with conversion coatings was never considered and to this effect, studies were initiated in 2008. Five types of coatings on Al alloys were studied: (a) cerium dioxide; (b) boehmite; (c) hydrotalcite (HTC); (d) cerium modified boehmite; (e) cerium modified HTC.

## EXPERIMENTAL PROCEDURE AND RESULTS

Aluminium alloy AA 1100 and AA 6061 specimens were pre-treated and coated in aqueous solutions [1] The corrosion resistance of coated specimens in 0.1 M NaCl was determined. The field tests consisted of preparing coated Al alloy coupons, 10 cm in diameter and 3 mm thick, stacking of these coupons in racks, immersion of the racks in the spent fuel section of the IEA-R1 research reactor in IPEN, Brazil, for 6 and 9 months, removal of the racks and examination of the coupons [2]. The morphology of the HTC and Ce modified HTC coatings are shown in figure 1. These coatings increased pitting corrosion resistance of Al alloy in the laboratory and field tests in the following order: Ce modified HTC > Ce modified Boehmite > HTC > Boehmite > Ce oxide. The HTC and boehmite coatings imparted 'passive corrosion protection' to Al alloys where as Ce modified HTC or boehmite coatings imparted 'active corrosion protection' to Al alloys.

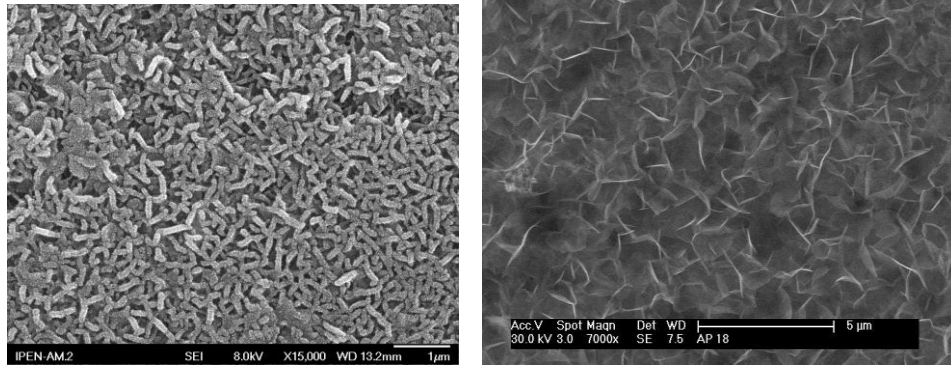


Figure 1. Micrographs of (a) HTC on AA 6061 from  $\text{NO}_3$  solution at  $95\text{ }^\circ\text{C}$   
(b) Cerium modified HTC on AA 1100 from  $\text{CO}_3$  solution at RT.

## CONCLUSIONS

1. HTC and boehmite coated AA 1100 and AA 6061 alloys exhibited increased pitting corrosion resistance in 0.1M NaCl. Modification of these coatings with cerium dioxide increased further the corrosion resistance.
2. Coupons of the alloys coated with boehmite and HTC when exposed the IEA-R1 reactor spent fuel section for 9 months did not reveal any pits where as the uncoated coupons of the two alloys revealed many pits.

## REFERENCES

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