

**Improvement of wear resistance of Zircaloy-4
by nitrogen implantation**

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ABSTRACT

Nitrogen implantation process has been applied for improvement of wear resistance of Zircaloy-4 fuel cladding materials. Nitrogen was implanted at 120 keV to a total dose range of 1×10^{17} ions/cm² to 8×10^{17} ions/cm² at various temperatures of 298°C to 676°C. The microstructure changes by nitrogen implantation were analyzed by using TEM, XRD and AES, and then wear behavior was evaluated by ball-on-disc wear testings at various loads and sliding velocity under unlubricated condition.

Nitrogen implantation produced ZrN_x nitride above 4.37×10^{17} ions/cm² as well as heavy dislocations, which enhanced microhardness of the implanted surface of up to 900 Hk from 200 Hk of unimplanted substrate. Hardness was also found to be increased with increasing implantation temperature and enhanced up to 800 Hk at 620 °C. the wear resistance was greatly improved with increasing total ion dose as well as implantation temperature.

The effective enhancement of wear resistance at high dose and temperatures is believed due to significant hardening associated with high degree of precipitation of Zr nitrides and generation of prismatic dislocation loops.