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SiC/Si Thin Film Deposited on Zircaloy to Improved Accident Tolerant Fuel Cladding

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Abstract

The protective coating layer for accident tolerance fuels (ATF) will offer a fuel efficient, enhanced oxidation resistance of zirconium alloy, and safe operation by active cooling of the reactor. The various coating methods on the surface of zirconium alloy such as physical vapor deposition, chemical vapor deposition, and cold spray have been tried to optimize the thin film layer for enhanced ATF performance. Among them, physical vapor deposition is a potential candidate for ATF coating layer due to its low temperature process ensuring mechanical strength of zircaloy cladding during coating process. The silicon carbide (SiC) is promising for extremely high irradiation doses, which provide saturated swelling after a few months of typical operation. As alternative claddings, SiC with various concentration of Si has been deposited on zircaloy cladding for the oxidation resistances. It has been tested at 900 °C for 500 hours in steam environment. The enhancement of oxidation resistance of SiC/Si composite coating layer was attributed to an oxidation of Si component to SiO_x during steam environments.

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