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Kinetic and microstructural studies of thermal decomposition in uranium mononitride compacts subjected to heating in high-purity helium

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Abstract

Although uranium mononitride has a high melting point (≈3100 K), it often decomposes well below this temperature. The threshold and kinetics of thermal decomposition depend on samples' chemical content and on gas environment. However, most experiments with uranium nitride samples were done so far in vacuum conditions and did not allow thorough examination of reaction kinetics at high temperatures. This research focuses on studying the different stages of thermal decomposition in uranium nitride samples subjected to heating in helium. Mass loss and thermal effects are identified with simultaneous thermal analysis (STA), while scanning electron microscopy (SEM) and X-ray diffraction (XRD) are used to register phase and compositional changes. Thermal decomposition in uranium nitride samples is found to be a multi-stage process with the final stage characterized by uranium vaporization. The results are useful for estimating the high-temperature behaviour of uranium nitride fuel during its fabrication and performance in some of Gen IV reactors.

Keywords: uranium nitride, thermal decomposition, simultaneous thermal analysis, scanning electron microscopy, X-ray diffraction

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