

Investigating the amorphous oxide growth on plutonium metal

Paul Roussel

AWE plc, Aldermaston, Reading, Berkshire. U.K. RG7 4PR

At room temperature some metals such as aluminium, chromium and tantalum form a thin (<10 nm) amorphous oxide film that is passivating, preventing further oxidation. This is a particularly desirable property for radioactive metals where gross oxidation forms respirable particulate which is extremely hazardous when ingested. The formation of an amorphous oxide on plutonium has been suggested by the absence of an X-ray diffraction pattern before and after the sample was observed to visibly tarnish [1]. The possible existence of an amorphous oxide on plutonium metal is investigated further here using three different approaches. First, thermodynamic calculations have been undertaken of both crystalline and amorphous oxide films and are compared. Secondly, X-ray diffraction measurements have been performed on monoclinic α -Pu using an environmental cell following oxidation at room temperature followed by heating in high vacuum. The composition is determined from the diffraction patterns using quantitative Rietveld refinement. Finally, an interesting signature in the X-ray photoelectron spectrum is tentatively assigned to amorphous and crystalline oxide formation on plutonium metal substrates.

[1] A. J. Nelson, P. Roussel, J. Vac. Sci. Technol. A **31**, 031406 (2013).

UK Ministry of Defence © Crown Owned Copyright 2026/AWE