Studies on the Formation of Molybdate-Based Coatings on Depleted Uranium-0.75wt% Titanium Alloy - C.R. Clayton, D.F. Roeper, D. Chidambaram, and G.P. Halada (State University of New York at Stony Brook)

The process of enriching uranium for atomic weapons and nuclear power plants results in the formation of a toxic and mildly radioactive waste. This high density, highly penetrating, self-sharpening (1) and pyrophoric byproduct called depleted uranium (DU) is used in combat munitions. Exposure to DU may have deleterious health effects (2-4). Hence, the leaching of uranium into the environment and its prevention become issues of concern. Protective coatings could prevent leaching of DU as well as prevent localized corrosion.

In this study we explore the formation of a molybdate-based coating on the DU-0.75 wt% Ti alloy (0.75 wt% Ti, less than 0.2 wt% ^{235}U and ~ 0.0008 wt % ^{234}U, rest being ^{238}U with some trace impurities), most commonly used in armor-piercing munitions. Sodium Molybdate (Na_2MoO_4) is an environmental-friendly corrosion inhibitor and has been tested for the protection of soft-water cooling systems (5).

The formation of a rudimentary molybdate-based coating on the surface of the alloy on exposure to a molybdate containing nitric acid solution has been demonstrated earlier (6). We have further explored the formation of this coating with and without the use of activators like fluoride. The optimal concentrations of the inhibitors and activators, as determined from the earlier study have been used. The morphological information has been obtained using optical microscopy and scanning electron microscopy (SEM). While open circuit potential (OCP) measurements, potentiodynamic polarization and atomic absorption spectroscopy have been utilized for characterization of the electrochemical behavior and chemical dissolution, the use of X-ray photoelectron spectroscopy (XPS) has provided the chemical information regarding the coatings. Our results indicate the primary constituent of the coating to be an uranium oxide-molybdate complex (UO_x-$(MoO_4)_y$). Molybdenum also appears to be in several oxidation states as observed from peak-fitting of the Mo3d spectra.

This study forms the initial stages in the development of a protective uranium-molybdate complex coating on the alloy surface. The characteristics of these coatings have been compared with other coatings similarly formed using different inhibitors and accelerators.

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