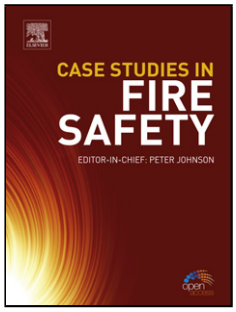


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# Effect of carbo-nitride-rich and oxide-rich inclusions on the pitting susceptibility of depleted uranium

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Highlights

- The Volta potential differences relative to the matrix are positive for both types of inclusions.
- Both types of inclusions are cathodic in the "inclusion/matrix" microgalvanic couples.
- The oxide-rich inclusions show a larger Volta potential value of about 115 mV than the carbo-nitride-rich inclusions.
- The oxide-rich inclusions give stronger local galvanic coupling with the matrix.
- The oxide-rich inclusions are more predisposed to initiate pitting corrosion.

**Abstract:** The effects of carbo-nitride-rich and oxide-rich inclusions on the pitting susceptibility of depleted uranium were investigated by electrochemical corrosion measurements, optical microscopy, scanning Kelvin probe force microscopy (SKPFM), and SEM. The results of the potentiodynamic polarization tests suggest that oxide-rich inclusions are more likely to induce pitting corrosion than carbo-nitride-rich inclusions. This enhanced corrosion may be explained by the strong local galvanic coupling between the oxide-rich inclusion and the surrounding matrix, which, from the sight of SKPFM analysis, exhibits a 115 V higher Volta potential than the coupling between the carbo-nitride-rich inclusions and the matrix, respectively.

## 1. Introduction

Because of its high density and nuclear properties, depleted uranium (DU) has widely been applied in civilian industry and national defense fields [1], including aircraft counterweights, radiation shielding, and penetrate armours. However, DU is thermodynamically unstable and therefore corrodes in aggressive environments [2]. In general, DU reacts with oxygen, moisture or aqueous solution to generate products of $UO_{2+x}$ (x is generally accepted between 0.06 and 0.1 [3,4]), $U_3O_8$, $UH_3$ [5,6]. To better understand the mechanism of its corrosion, a number of investigations have been undertaken in *in situ* and laboratory conditions [7-12]. In most cases, the studies found that the corrosion does not occur in a uniform manner, where pitting corrosion is the dominant process for DU under certain circumstances. These studies concluded that DU corrosion is affected by several factors, notably the temperature and the presence of inclusions, oxygen, hydrogen, water, chloride, and other ions [13-17].

Inclusions based on particularly carbo-nitrides and oxides are very common in cast uranium. For example, the solubility of carbon in α-uranium is less than 3 ppm, thus the uranium carbides are prior to separate out from liquid uranium duo to its high melting point (2780 K). Stoichiometric uranium mono-carbide is stable at room temperature. However, UC