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# The effect of surface contamination on corrosion performance of ultrasonic shot peened 7150 Al alloy

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**Abstract**: Surface contamination layer mainly containing Fe, Ti and O with a thickness of ~20 μm was induced on AA 7150 surface during ultrasonic shot peening (USSP) treatment. The contaminated layer and its exfoliation evolution in solution containing HCl was investigated using immersion test, electrochemical impedance spectra (EIS), scanning kelvin probe force microscopy (SKPFM), SEM with energy-dispersive X-ray spectroscopy, XRD and TEM. USSPed AA 7150 with contamination layer showed ~3 times higher corrosion rate than that of controlled sample. However, after the exfoliation of the contamination layer, the corrosion rate of USSPed alloy actually is lower than that of its untreated counterpart. Additionally, as revealed by SKPFM, surface contamination layer is cathodic relative to the substrate, indicating that surface contamination layer is detrimental for the substrate alloy when galvanic corrosion occurs. Nonetheless, it should be noted that even in the presence of contamination layer, the localized corrosion resistance of peened alloy was greatly improved, which might be due to surface nanocrystallization, disappearance of rolled <220> texture and residual compressive stress effects caused by USSP.

**Key words**: AA 7150; ultrasonic shot peening; surface contamination; corrosion; scanning kelvin probe

## 1. Introduction

Ultrasonic shot peening is a recently developed surface mechanical attrition treatment (SMAT) technology [1-3]. SMAT is one technique that uses multi-directional and high velocity metal/ceramic balls to induce severe plastic deformation (SPD) on the surface of an alloy, resulting in a strain harden effect, refinement of grain size and second phase particles (down to nanometer scale) and compressive stress effect [4-8]. Unlike other surface nanocrystallization methods such as PVC, CVD and sputtering, there is no interface between the nanostructured surface layer and the substrate because SMAT leads to a gradient microstructure gradually changing from surface to interior. Bulk SPD methods such as equal channel angular pressing (ECAP), high pressure torsion (HPT), accumulative roll bonding (ARB) and twist extrusion (TE) also form nanocrystalline grains and result in a spectacular enhancement of strength, however, with a huge loss in ductility. The ideal structural material should combine high strength with sufficient ductility. SMAT can maintain a good ductility while strengthening surface of alloy to enhance wear, friction and fatigue resistance.

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