

TRIB-P2-201 • Plasma Electrolytic Oxidation of additively manufactured AlSi10Mg alloy

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Plasma Electrolytic Oxidation (PEO) is the most advanced of the anodizing methods. In comparison to traditional anodizing PEO provides coatings with higher wear- and corrosion- resistance and hardness. Moreover, PEO is carried out in an alkalic bath, instead of strong acids, which makes this method more environmentally friendly.

PEO is an excellent surface treatment for light metals, like magnesium or aluminium. More often light metals are produced by additive technologies (3d printing). The microstructure of additively manufactured alloys strongly differs from casting alloys. Characteristic melting pools are observed. AlSi10Mg alloy presents eutectic structure surrounded by Si-net. The microstructure is strongly connected to laser paths. Fine-grain microstructure results in higher strength than cast alloy.

In this study, traditional anodizing, hard anodizing (HA) and PEO were carried out on AlSi10Mg manufactured by Direct Metal Laser Sintering (DMLS). Moreover, PEO was also performed on cast AlSi10Mg alloy. Thin, conversion coatings were obtained (thickness under 10 μm). A microstructure of oxide coatings was observed. Scratch resistance was tested and allowed to describe the films' adhesion.

PEO coatings are vastly porous and include more SiO_2 oxides than traditional and HA coatings. SiO_2 oxides are more difficult to obtain as silicon has higher resistance than aluminium. Moreover, PEO guarantees more phase-mixed surface microstructure, including amorphous, ceramic phases, which cannot be formed in low-voltage processes. In comparison to traditional and HA oxide coatings, PEO coatings exhibit better adhesion and scratch resistance. Traditional anodizing and hard anodizing on additively manufactured AlSi10Mg provide the critical load LC1 at which coating begins to be broken of 8.5N and 10N respectively. A similar LC1 value can be obtained for PEO performed on cast alloy (7.8N), while in the case of additively manufactured AlSi10Mg this LC1 is increased four times to 42.1N.

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