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Plasma Electrolytic Oxidation with Alternating Current and Asymmetric Electrodes

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Plasma electrolytic oxidation (PEO) is an electrochemical process to create ceramic-like oxide coatings on light alloys like aluminum, magnesium and titanium. Similar to conventional anodizing, in PEO the coating process occurs on the anode. The major difference in PEO is that the anode-potential reaches the dielectric breakdown voltage, which causes discharges on the surface. This results in interesting tribological properties as well as high biocompatibility and durability, making PEO increasingly important for material and surface technologies that are used in optical, space and medical applications. It has been shown that the application of pulsed alternating current (AC) improves the quality of the coating. Using AC also allows for coating two objects simultaneously, with each object acting as one of the electrodes. This is possible since each electrode functions as the anode during its corresponding negative pulse half-cycle. Coating two objects at the same time doubles the efficiency of the process. In practice, however, this is difficult to achieve because of differing electrode sizes and shapes. The coating process is also inherently unstable towards one of the electrodes: the coating on one of the objects grows faster, which leads to a runaway effect of the process. To compensate for this effect, we have developed a power supply and an electronic control system that adjusts current and waveform to stabilize the AC-PEO process. The system facilitates uniform coatings on asymmetric electrode configurations, which opens the technology to new applications in research and development as well as for industrial use.

Keywords
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