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Surface cleaning and surface modifications through the development of a novel technology of electrolytic plasma process (EPP)

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Abstract

Electrolytic plasma process is an efficient surface modification method for metallic materials. With proper control of the process parameters Electro-Plasma-Process (EPP) could generate unique surface morphology, which is suitable for effective cleaning of the metallic surfaces and surface modifications; inherently, good adhesion strength can be achieved for eventual coating the surfaces. Increasing input voltage beyond the conventional Faraday region of electrolysis, luminous discharge is observed on the surface of one of the electrodes. The electrode surface must be covered by layers of bubbles before the discharge could be set in. The discharge of energy is then taken place in an explosive way with localized high temperature. The combination of heat and kinetic impact could effectively remove the surface contaminants and could produce a unique surface morphology. In this paper, the conditions of process control parameters and the resultant surface conditions that could be achieved are studied. It has been found that elevated temperature is beneficial towards the plasma formation on electrodes; and the increase of temperature essentially increases the kinetic energy of electrons in the electrolytic solution and a high electrolyte temperature assists the boiling process and the chemical reactions that generate bubbles. The conductivity of the electrolytic solution could also affect the threshold voltage and the current density, but the total power input does not vary significantly with conductivity. Environmental pressure has been proved to be the single most critical important factor for Electro Plasma Process; and by increasing the pressure level the total breakdown energy tends to increase and more importantly, the resultant surfaces manifest that the energy consumed for surface modification increases with pressure.

Key words: *Electro-plasma process, Electrolytic discharge, Surface cleaning, Surface modifications, Pressure-effects on discharge, Electrolytic concentration, Cathodic discharge, Electrical conductivity*

1. Introduction

For decades, plasma discharge in electrolyte has been studied and this technology has been used for its high efficiency and its suitability to create unique surface morphology after imparting plasma discharge treatment on the surface of one of the electrodes. In the conventional

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