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APDBD plasma deposition of SiOxCy(-H) thin film for corrosion protection of magnesium alloy

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Magnesium alloys can be widely used in automobile, aerospace, and mobile electronics components because of its high strength/weight ratio, high thermal conductivity, high dimensional stability, and good electromagnetic shielding characteristics. However, magnesium alloys have poor corrosion resistance and wear resistance, which restrict its application. One of the most effective methods to protect metals from corrosion environment is to coat them with organic thin films. There were several reports that the organosilicon films polymerized from hexamethyldisiloxane (HMDSO) using low pressure plasma improved the corrosion behavior of steels and aluminum alloys. However, the low pressure plasma process was not cost effective because of expensive vacuum pumping systems and the limitation of mass production.
In this study, we try to directly deposit $SiO_xC_y(-H_z)$ films on magnesium alloy using atmospheric pressure dielectric barrier discharge (APDBD). The APDBD apparatus is relatively simple and cheap but suitable for mass production to coat large sheet metal with organosilicon. The $SiO_xC_y(-H_z)$ films were deposited from a mixture of hexamethylcyclotrisiloxane (HMCTSO), oxygen, and helium. The compositions of $SiO_xC_y(-H_z)$ films were controlled from SiOC to SiO_2-like by changing flow rates of HMCTSO and oxygen. We investigated the $SiO_xC_y(-H_z)$ film properties by Fourier transform infrared spectroscopy, scanning electron microscopy, atomic force microscopy, and X-ray photoelectron spectroscopy. The anti-corrosion behaviors of the coated magnesium are evaluated by electrochemical impedance spectroscopy and potentiodynamic polarization curves. The results indicate that the corrosion resistance of magnesium alloys is greatly improved by $SiO_xC_y(-H_z)$ films. We will discuss the influences of elemental composition and chemical structure of $SiO_xC_y(-H_z)$ films on corrosion behavior of the magnesium alloys.

Keywords
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