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A Study of in-situ plasma nitrocarburizing-PEMOCVD duplex-treated thin coating films for metallic bipolar plate of PEMFC

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Metallic bipolar plate for PEMFC (Polymer Electrolyte Membrane Fuel Cell) are becoming lighter and thinner in terms of power density, specific power and cost. Such metallic bipolar plate needs various properties and reliability required in a fuel cell stack, and therefore it is urgent to develop new surface treatment technology that can be satisfied requirements.

In this study, new duplex-treatment which are consisted with plasma nitrocarburizing and PEMOCVD processes are investigated for stainless steel 316 plate. Very thin carbon-based metal coating films are performed on the substrate in two steps in-situ. Plasma nitrocarburizing process penetrates nitrogen and carbon on the substrate surface to form a diffusion layer, so-called S-phase. The carbon-based coating films are deposited by MOPECVD process from acetylene and MO-precursor (Metal Organic Precursor) mixed gas. The S-phase and thin carbon-based metal films are observed using TEM, FE-SEM. The thickness of films is under the several tens of nanometer size and the grains are 5 ~ 40 nm. The interfacial contact resistance (ICR) and corrosion resistance of carbon-based metal films are compared with gold coatings. ICR and corrosion resistance results are closely related to grain size of films. The best ICR and corrosion resistance of carbon-based metal films are 13.3 mΩ·cm² and 0.387 uA/cm² respectively and these results are equivalent to or better than gold coatings.

Keywords

Carbon-based metal film
PEMOCVD
Duplex treatment
Metallic bipolar plate
PEMFC