Influence of Slurry Properties on Coatings of Fine Particles on Porous Substrates

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Abstract

Controlling and characterizing slurry properties are key technologies to determine the state of the coatings. In this research the effect of slurry preparation conditions on coating on porous substrates has been investigated. Since coating on porous substrate is quite different from coating on flat and smooth surface, thus, a lot of past findings cannot be directly applied. Therefore, in this paper, we tried to clarify the relationship between the slurry properties and the coating state.

Aqueous alumina slurries were prepared changing the type of additives, that is, a nonionic polymer, polyethylene glycol (denotes PEG), a cationic polymer, polyethylenimine (denotes PEI), and an anionic polymer, sodium carboxymethyl cellulose (denotes CMC). The initial particle concentration and the additive amount of polymer were 2.0 vol% and 2.4 mass%. An alumina sol was also added as an inorganic binder. The prepared slurry was coated on the porous SiC substrate by spin coating. The flow curve of the prepared slurry was measured and its particle dispersion state was also observed directly by using an optical microscope. In addition the surface and cross section of the coating was observed by SEM and analyzed by EDX. The air permeability of the coating was measured at a constant flow rate.

It was found that slurries with PEG and CMC had a high viscosity and a yield stress, while the slurry with PEI had a low viscosity. From directly observation of particle dispersion state, the particles formed aggregates in the slurry with CMC. These results indicated that the aggregated particles caused a high viscosity for the slurry with CMC, however, on the other hand, the polymer network structure causes a high viscosity for the slurry with PEG. It was shown that the coating fabricated from the slurry with PEG had a relatively low permeation resistance even though the particles well dispersed, that means the particles were easy to penetrate the substrate. In addition, it was shown that the coatings fabricated from the slurry with PEI also had a relatively low permeation resistance since the particles did not penetrate into the substrate due to the electrostatic interaction between positively charged particles and negatively charged substrate.