主 論 文 要 旨

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論 文 題 名　 Influence of Atmospheric Composition on Growth of Smoke Particles

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主論文要旨

The influence of atmospheric species on the growth mechanism of smoke particles was studied by the gas evaporation method for elucidating the mechanisms responsible for two phenomena: the degradation of Pt catalyst in fuel cells and growth of cosmic dust clouds.

In fuel cells, Pt-C catalyst operates in an atmosphere containing H_2 and/or O_2 saturated with water vapor at 80°C. The structural changes attributable to these atmospheres were elucidated by comparing a surface-exposed Pt cluster on a carbon particle with a surface-embedded Pt cluster in a carbon particle. In the dry state, it was found that H_2 directly induces coalescence growth of Pt clusters, whereas O_2 causes amorphization via oxidation of the carbon on the surface. The same reactions occurred in atmospheres saturated with water vapor, but the responses were slower.

Evaporation of a newly developed carbon boat with Pt in an inert gas atmosphere afforded Pt clusters covered with graphene layers via eutectic reaction of Pt-C. Replacement of the inert gas with CO_2, however, produced Pt smoke particles without carbon layers.

For the second system, candidate materials for cosmic dust, TiC and TiO particles, were produced by evaporation of a newly developed titanium-coated carbon source. SiO smoke particles could be produced by oxidation of CO and Si. SiO smoke particle evaporated in H_2 gas showed new infrared absorption peaks. SiO is a precursor to the silicate present in across the universe. Since the result showed that CO is not the most stable molecule in the dust forming region, the formation of Mg-bearing silicate particles would requires not an oxygen-rich environment but sufficient SiO-Mg. This was elucidated by a newly developed experiment utilizing the powder-fall-control flash evaporation method.