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デカン酸自己組織化膜修飾酸化セリウムナノ粒子の無極性有機溶媒中への高濃度（20 vol%以上）コロイド分散

Colloidal dispersion of decanoic acid self-assembled monolayer stabilized Cerium Oxide nanoparticles up to 20 vol% in nonpolar organic solvents.

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Concentrated nanofluids are awaited to be developed because of their potential application on heat transfer, refractive and dielectric media. In order to perfectly disperse inorganic nanoparticles (NPs) in hydrophobic media including organic solvents and polymers, surface control of the polar NPs' surface is absolutely important. Actually, surface modifications of NPs by organic modifiers have succeeded to disperse NPs and already been recognized as a common procedure. Alkanoic acid modifiers on NPs often form dense self-assembled monolayers (SAMs). The dispersion of the NPs can be improved by increasing the packing density of alkanoic acid SAM on the NPs. To achieve perfect and stable dispersion at very high NPs concentration, total design of the NP containing composite (hybrid material) should be reconsidered.

In our former studies, individual factor which affects dispersion of NP in organic solvents, e.g., packing density of surface modifier on NP, size and size distribution of NP, solvent quality and chain length of surface modifier been experimentally investigated and associated with dispersion of the NP in organic solvents.[1-3] According to the dispersion model, perfect dispersion of the cerium oxide NP at high concentration in cyclohexane[4] and *trans*-decalin[5] was achieved as suggested.

Decanoic acid SAM protected cerium oxide NPs prepared in this study had averaged particle core size as 6.5 ± 0.86 nm. XRD result supported the core material was CeO_2. The FTIR, TG and dry-state DSC results supported dense decanoic acid SAM was formed on the surface of the cerium oxide NPs. The packing density of the decanoic acid in the SAM was calculated as 5.0 chains/nm^2. The density was close to the maximum packing density of fatty acid SAMs, i.e., 5.2 chains/nm^2 which calculated from crystalline density of bulk fatty acids.[5] By using the relationship between the strength of the Rayleigh scattering and the volume fraction of the particles, we examined dispersion of the cerium oxide NPs solution at high concentration. As a result, perfect dispersion (without any flocculation) of the cerium oxide NPs was achieved around 10 vol% of the cerium oxide NPs (modifier SAM was eliminated from the volume fraction) was seen in cyclohexane and *trans*-decalin. In addition, we did not see precipitation even in the 23 vol% dispersion of the cerium oxide NPs. The dispersion in cyclohexane was stable more than 3 months, whereas in the case of *trans*-decalin, it showed precipitation 3 months after preparation.

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