Synopsis of Original Research Paper

Development of structural color by integration and layering of surfactant-modified nanodiamonds and antibacterial thixotropic coatings

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The surfaces of nanodiamond particles are modified using natural castor oil-derived 12-hydroxystearic (12-OHSt) acid, which has thixotropic solvent properties. 12-Hydroxystearyl chain-modified nanodiamonds (12OHSt-ND) are spread from a dispersion medium onto ultrapure water to afford Langmuir monolayers (a single-particle layer) of 12OHSt-ND exhibited a two-dimensional phase transition from an expanded phase to a condensed phase. The surface morphology of the single-particle layer shows a dispersed form of aggregated particles, while the layered regularity of the multilayers shows high periodicity. The surface hydrophobicity of the single-particle layer of 12OHSt-ND is more pronounced than that of the single-particle layer of stearic acid-modified nanodiamonds. The origin of the surface hydrophobicity of the single-particle layer of 12OHSt-ND is predicted to be the vertical conformation of the modified chains achieved via hydrogen bonding between the modified chains. In addition, the stepwise multilayers of 12OHSt-ND exhibit various structural colors depending on the number of layers.

Further, gel coating films comprising nanodiamonds organo-modified with 12-OHSt and stearic acids were prepared and characterized. Because molecules with 12-OHSt groups can convert solvents into thixotropic gels, Gemini-type diamide derivatives with two 12-OHSt chains were also introduced as thixotropic additives into the gel coating films. Although the 12OHSt-NDs did not lead to solvent gelation on their own, they displayed an affinity for the thixotropic additive molecules. The 12OHSt-NDs were localized near the surface of the nanofibers formed by the Gemini-type diamide derivative in the solvent, and the thixotropic properties of the supramolecular gel were confirmed. Nanoparticle aggregation and nanofiber crystallinity were found to be suppressed by the effect of 12-OHSt modification in the gel coating films, making them suitable for cosmetic coating applications.