Preparation of Cross-Linked Liquid-Crystalline Polymer Particles with Precisely Controlled Molecular Orientation

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Monodispersed liquid-crystalline (LC) polymer microparticles which exhibit unique optical properties have been developed. The introduction of crosslinking structures in the LC polymer microparticles can enhance their environmental stability against heat and solvents. In this study, we developed a new hetero-bifunctional crosslinker showing liquid crystallinity that can crosslink the LC polymers with an arbitrary crosslinking density.

Non-crosslinked microparticles were obtained by dispersion polymerization of the LC crosslinker in a DMF/MeOH mixture. The non-crosslinked microparticles were then redispersed in MeOH containing a photoacid generator and irradiated with UV light at 65 nm to induce ring-opening polymerization of the oxetane ring to introduce a crosslinked structure. The resulting microparticles showed a cross-shaped dark field inside the particles, indicating that the LC molecules were radially oriented. The crosslinked particles did not dissolve in dichloromethane. This indicates that a crosslinked structure was successfully introduced into the microparticles, and highly crosslinked liquid crystalline polymer microparticles were synthesized.

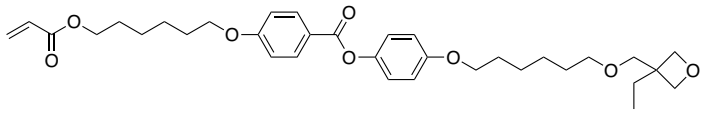

Figure 1. Molecular design of LC crosslinker

The average size of the particles was estimated to be 3.6 ± 0.2 μm by image analysis. POM observation revealed a cross-shaped optical texture, suggesting that the molecules are oriented radially inside the particles. Although the non-crosslinked particles were dissolved in a good solvent for the polymer (dichloromethane), the crosslinked particles did not dissolve in the solvent (Figure 2e,f). Thus, we can conclude that we successfully introduced a cross-linked structure into the microparticles.

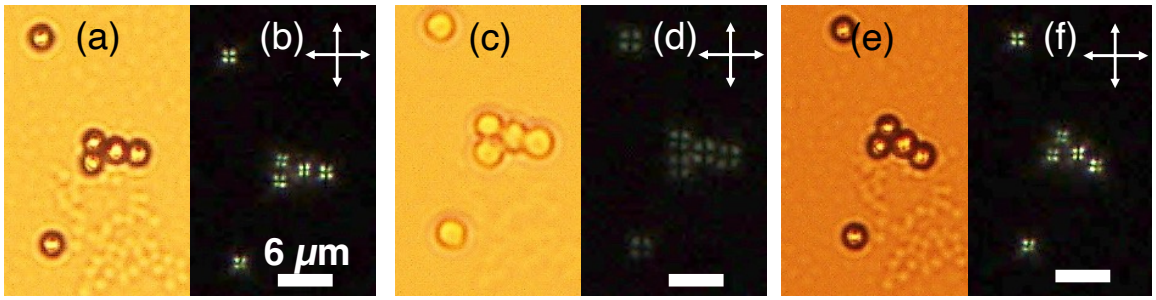

Figure 2. Optical and crossed nicol micrographs of the crosslinked particles: (a, b) in air, (c,d) in CH_2Cl_2, (e, f) in air after of evaporation CH_2Cl_2.