3-Dimensional Control of Nanostructure of Chiral-Nematic Liquid-Crystals in Monodispersed Polymeric Microparticles

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Chiral-nematic liquid-crystals (N* LCs), which spontaneously form helical nanostructure of molecular orientation, exhibit Bragg reflection depending on the alignment of helical nanostructure. Among various application of N* LC, the polymeric microparticles have attracted much attention as small optical elements. Recentry, N* LC polymeric particles have been produced by the polymerization of N* LC monomer droplets. Therefore, the nanostructure that can be realized was limited. In this study, we found unique nanostructure in the N* LC polymeric particles fabricated by dispersion polymerization. In dispersion polymerization, a large number of monodisperse microparticles can be obtained in single-step. The resulting polymer precipitates and grows to form monodisperse particles.

From the scanning electron microscopy (SEM) image (Figure 1a), the average particle size of the obtained particles was 2.6 ± 0.1 μm, indicating that monodispersed particles were obtained. In addition, transmission electron microscopy (TEM) image of the cross-section showed spiral stripe pattern from two orientation defects (Figure 1b). The nanostructre predicted by this pattern was different from that of fabricated by the conventional method. We now expect that this nanostructure was formed during the growth process of the particles during dispersion polymerization.

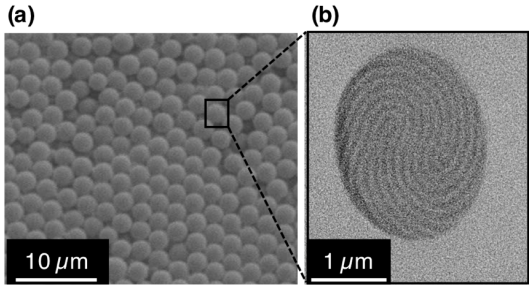

Figure 1. (a) SEM image and (b) TEM image of the N* LC particles fabricated in this study.

Next, we investigated the optical function of N* LC particles. Figure 2 shows the characters drawn using the N* LC particle ink. The drawn characters showed a angular-independent reflection because of their centrally symmetric nanostructures.

The monodispersed N* LC particles developed in this study can be applied to reflective coatings and security inks utilizing the circularly polarized reflective property of N* LC.

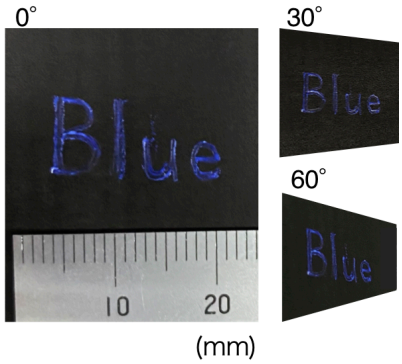

Figure 2. Refractive coating of the N* LC particles and its reflection color observed from 0°, 30° and 60°.

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