

TITLE: ASSEMBLED ACHIRAL MOLECULES FOR CHIRAL APPLICATION

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ABSTRACT

Chiral liquid crystal phases show fascinating structural and optical properties due to their inherent helical characteristics. Among various chiral LC phases, the helical nanofilament (HNF) phase made of achiral bent-shaped molecules has been keenly interested due to its unusual polar and chiral properties. This talk is intended to introduce the recent progress in orientation control and its application to the HNF phase, which includes the photoalignment of the HNF phase and chiroptical applications such as photonic crystal, chirality sensor, and security use. In detail, irradiating a film comprising azobenzene derivatives with UV light produces oriented arrays of HNFs via the photoisomerization-induced Weigert effect. As a result, structural colors are observed due to the irrelevant chiral reflection in the visible wavelength range, and the reflected color can be tuned by adjusting the molecular length of the azobenzene derivative. We also have directly visualized the optical activity of chiral samples using orientation-controlled HNFs. Right- or left-handed domains of the HNFs are large enough to be seen with the naked eye, up to ~several mm². Due to the Bragg reflection, the periodic arrays of aligned HNFs reflect a green color. Such a reflector enables easy detection of the optical activity of a sample placed on it. The device was tested with naturally chiral substances, like fructose and glucose, which exhibit an opposite sense of optical activity and with structurally chiral nematic LC phase and revealed high detection sensitivity. Indeed, we demonstrated security codes based on chiral photonic crystals made of HNFs that are not easy to mimic, which is quite different from the current conventional technology. The HNF-based chiral photonic crystals show the structural colors changed depending on the polarization of the light in the transmission mode. These color changes are easily detected in real-time, which is helpful for fabricating anti-counterfeiting patterns that show beautiful and diverse color changes during rotating polarizers. We believe these resultant optical applications can provide a new platform in various colors and further applications.