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Editorial

Liquid Crystal Optics and Physics: Recent Advances and Prospects

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For more than 100 years, liquid crystals (LCs) have been extensively investigated and LC displays now are becoming ubiquitous in our daily life, from TVs, mobile phones to indoor/outdoor signage. However, the LC display technology is maturing very fast and the LC display industry is gradually saturating due to the rapid progress with other emerging display technologies including Organic Light Emitting Diode (OLED) and micro-LED displays. Nonetheless, LCs with many unique physical properties have been considered to be an optical material for applications ranging from optical elements to photonic circuits beyond display applications. Traditional rod-like nematic LCs with large physical anisotropies enables superior light modulation such as optical phase, intensity, and polarization, and other special kinds of LCs (e.g., cholesteric, blue phases, and ferroelectric liquid crystals), exhibiting unique helical structures or electro-optic properties have potential for manipulating light spectrally and/or temporally and generating lasers. As more and more photonic devices/systems based on LCs are developing, we published this special issue "Liquid Crystal Optics and Physics: Recent Advances and Prospects" to present the latest research primarily related to LC material or technologies.

This special issue includes six contributed articles and one review article. Two of the contributed articles report on LC lenses. Dr. Wei Hu et al. developed a Pancharatnam-Berry phase lens with fast response time (<1 ms) via dual-frequency liquid crystals [1]. Such a LC lens that is fabricated using the dynamic photo-patterning technique exhibits distinctive polarization-dependent characteristics and ultra-high efficiency rates of up to 95%. Dr. Qiong-Hua Wang et al. proposed an electrically tunable-focusing LC microlens array with a simple electrode structure [2]. According to the simulation result this LC microlens has a tunable focal length with a minimum focal length of 0.381 mm at a small applied voltage of 4.8 Vrms. Dr. Jiangang Lu et al. presented a near-infrared (NIR) filter and multi-wavelength filters, which were realized by sphere phase LC and templated blue phase LC, respectively. The sphere phase LC filter exhibits a wide wavelength tuning range of 256 nm by thermal modulation and 76 nm by electrical modulation [3], and the templated blue phase LC may reflect multi-wavelengths in one filter with a much narrower reflection bandwidth of less than 15 nm [4]. Dr. Tae-Hoon Yoon et al. proposed a systematic approach to maximize the maximum transmittance difference in a guest-host liquid crystal cell and experimentally examined this approach by designing a guest-host liquid crystal cell with the desired performance [5]. Dr. Zhi-Yong Tao et al. theoretically and numerically demonstrated a type of electric field sensor based on the Bragg defect structure filled with LC E7 material in the THz frequency [6]. The simulated results showed that the sensitivity could reach as high as 9.164 MHz/(V/m) and the smallest resolution was 0.1115 V/m. Dr. Qi Guo et al. reviewed three electrooptic modes including surface stabilized ferroelectric liquid crystals, the deformed helix ferroelectric mode, and electrically suppressed helix mode [7]. The general operation principles ferroelectric LC electrooptic modes are described, then the characteristics of each mode for potential applications are summarized.

The variety of LC materials and physical properties makes them promising for the development of basic physics research and advanced photonic devices. This special issue covers many articles reporting tunable photonic devices based on LCs. We hope that these articles will encourage engineers and scientists to continue to study physics and develop technologies in the field of LCs. We thank all the authors for their contribution to this special issue and all the Crystals employees for their assistance and support during the preparation of this special issue.

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