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Coupled chiral optical Tamm states in liquid crystals

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The optical Tamm state (OTS) attracts particular attention of researches among various surface localized optical states. This is a mode localized at the interface between two highly reflecting media, which exponentially decreases to both of them [1]. We theoretically demonstrated the existence of the modes caused by coupling of two chiral optical Tamm states localized at the interface between the cholesteric liquid crystal (CLC) and two polarization-preserving anisotropic mirrors (PPAMs) [2]. The mirrors represent uniaxial layered structures, in which each layer is rotated by 90° relative to the previous one. The system under study is presented in Fig. 1. The need for these mirrors is caused by the outstanding polarization properties of the CLC.

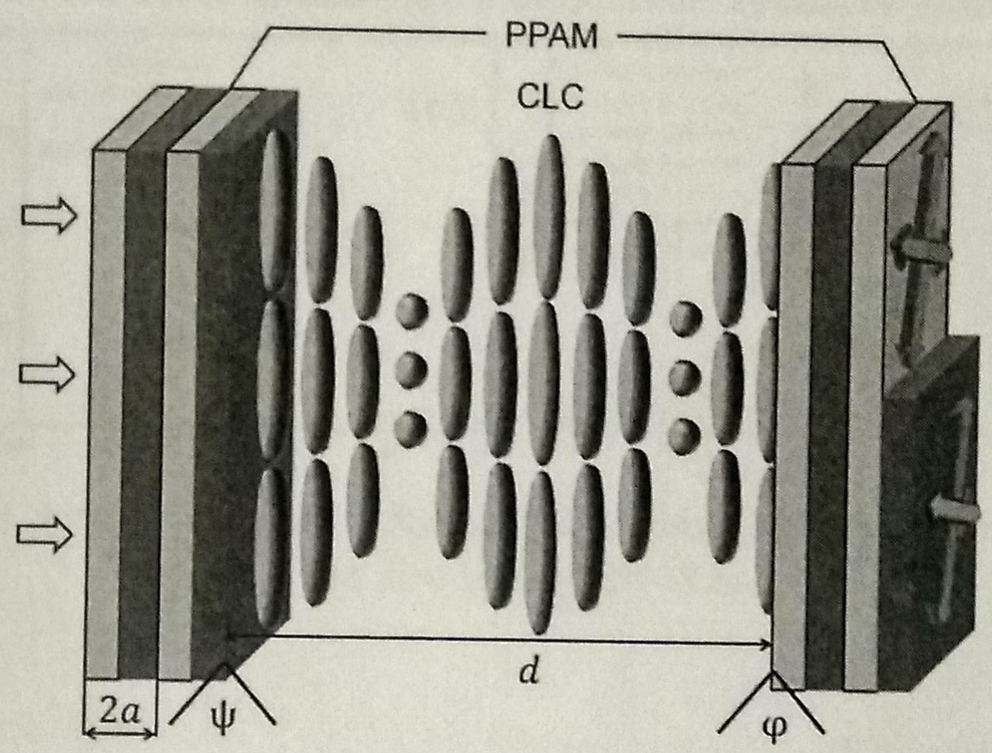

Fig. 1. Schematic of the structure. Color arrows show the direction of optical axes of the PPAM layers. Each PPAM consists of 10 periods.

The investigated modes are only excited at the diffracting polarization of the incident light. As the CLC layer thickness decreases, the OTS frequency spectral split is observed. The split value depends on the layer thickness. We found analytically and numerically the frequencies of the spectral manifestation of the chiral OTSs [3]. Varying the angle between the CLC and PPAM optical axes, one can control the OTS coupling value, thereby tuning the transmittance spectrum of the structure. At the opposite circular polarization, which does not reflect from the CLC, the OTSs are not excited and the system becomes analogous to a Fabry–Perot cavity filled with an anisotropic helical structure.

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