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Chiral Optical Tamm State at the Interface between Multilayer Polarization-Preserving Anisotropic Mirror and Cholesteric

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Optical Tamm state [1] is a special localized light wave exactly at the interface between two mirrors. This state is distinct from surface plasmon-polariton because it can be excited at arbitrary angles and does not require total internal reflection. On the other hand, this state is distinct from optical cavity mode because it has no free cavity space and its energy is completely localized inside the bulk mirrors. The chiral optical Tamm state [2] is a new localized state of light at the interface between a polarization-preserving anisotropic mirror [3] and an optically chiral medium such as a cholesteric liquid crystal (Fig. 1).

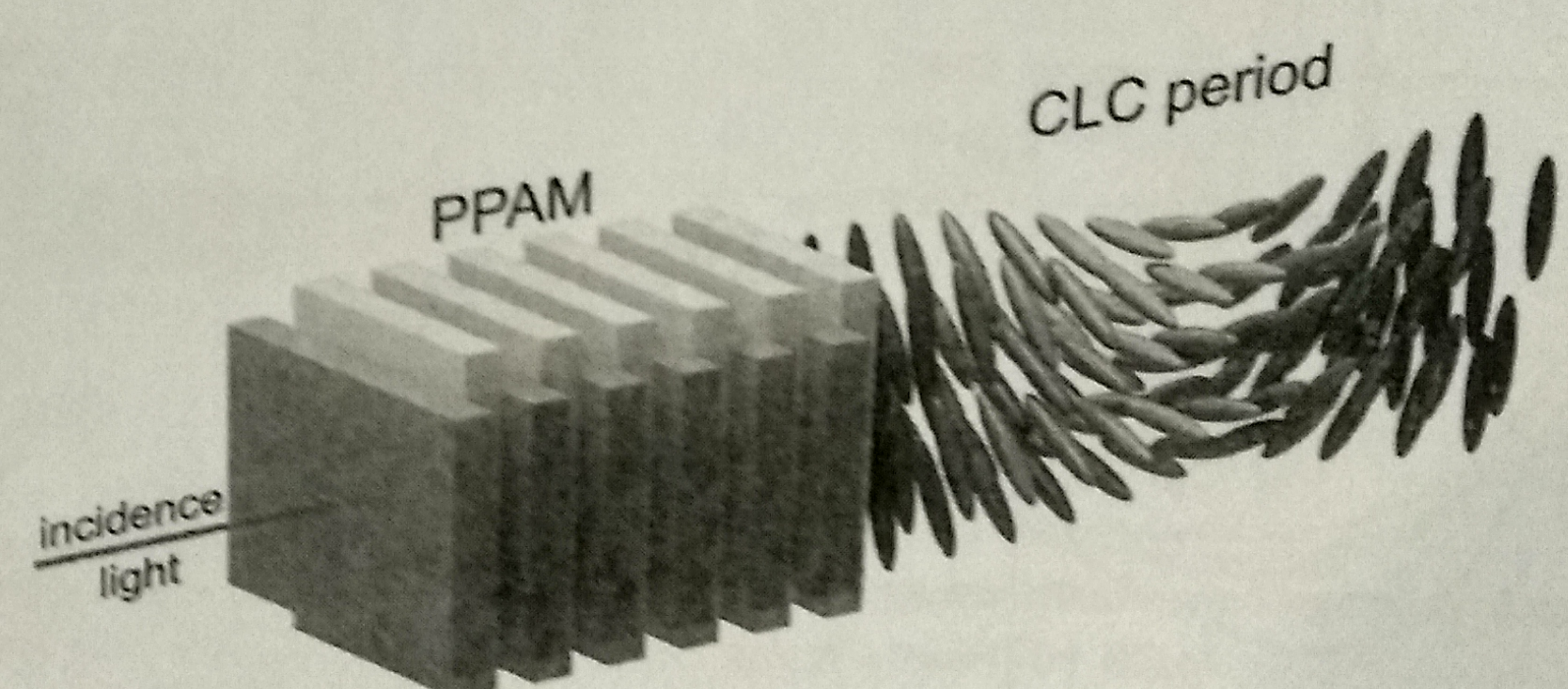

Fig.1 Schematic of the interface between polarization-preserving anisotropic mirror (PPAM) and cholesteric liquid crystal (CLC). The CLC period is shown stretched for better visual perception.

In this study the metal-free polarization-preserving mirror is used rather than the metallic metasurface [4]. We stress the advantage of the all-dielectric structure in obtaining high Q factor. The light is localized near the interface and the field decreases exponentially with the distance from the interface. The penetration of the field into the chiral medium is virtually blocked at wavelengths corresponding to the photonic band gap and close to the pitch of the helix. The polarization-preserving anisotropic mirror has another photonic band gap as well. The energy flow along the interface can be efficiently stopped by setting the tangential wave vector to zero. The spectral behavior of the chiral optical Tamm state is observed both as reflection and transmission resonance. The resonance is described in terms of decay rates. Our analytics agrees well with precise calculations, enabling intelligent design for laser and sensing applications.

References

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