Transition from Optical Bound States in the Continuum to Leaky Resonances: Role of Substrate and Roughness - DTU Orbit (09/12/2018)

Optical bound states in the continuum (BIC) are localized states with energy lying above the light line and having infinite lifetime. Any losses taking place in real systems result in transformation of the bound states into resonant states with finite lifetime. In this Letter, we analyze properties of BIC in CMOS-compatible one-dimensional photonic structure based on silicon-on-insulator wafer at telecommunication wavelengths, where the absorption of silicon is negligible. We reveal that a high-index substrate could destroy both off-Γ BIC and in-plane symmetry protected at-Γ BIC turning them into resonant states due to leakage into the diffraction channels opening in the substrate. We show how two concurrent loss mechanisms, scattering due to surface roughness and leakage into substrate, contribute to the suppression of the resonance lifetime and specify the condition when one of the mechanisms becomes dominant. The obtained results provide useful guidelines for practical implementations of structures supporting optical bound states in the continuum.

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