Bound states in the continuum in the near UV regime

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Bound in the continuum state (BIC) is an optical state that can arise in a periodic structure due to destructive interferences of all radiative channels. It coexists with a continuous spectrum of unbound states and the quality (Q) factor of BIC state approaches infinity. In real systems, due to finite dimensions, one observes so-called quasi-BIC, with a finite Q-factor. Subwavelength gratings are diffraction gratings, with periodicity smaller than the wavelength of incident light. They are a canonical example of an open optical system that can confine BIC states.

We present a set of subwavelength gratings etched in gallium nitride on a sapphire substrate, where the width of the stripe was varied. GaN has been selected for its thermal and optical properties, mostly for low absorption in the visible spectrum. The gratings were produced by electron beam lithography followed by dry-etching. Figure 1a) shows an example of the angle resolved reflectivity map of the grating with the period of 410 nm. Multiple modes show anomalous (negative) dispersion of the confined optical mode. Presence of vanishing reflectivity features at photon transversal momentum $k = 0$ in some of the modes confirms the existence of quasi-BIC states. Polarization resolved measurements reveal the presence of vortexes in reflected light, see Figure 1b), which further supports existence of quasi-BIC [1]. Those observations hold true for modes with wavelengths shorter than 435 nm, which lie in the near UV regime. Such modes are rarely observed in case of subwavelength gratings, due to difficulties in manufacturing structures with sufficiently low period and uniformity. These findings can be promising for optical signal processing in information technology.

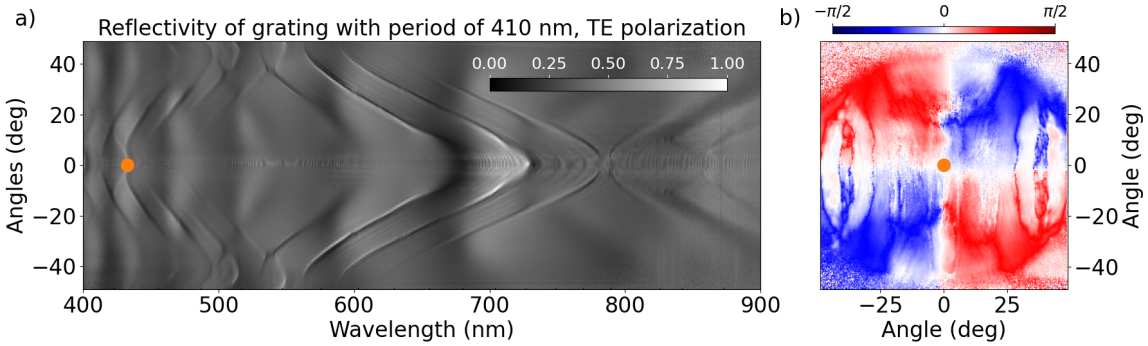

Figure 1: a) Angle resolved reflectivity measurements of GaN on sapphire subwavelength grating. BIC states are observed at $k = 0$ (orange point). b) Polarization vortex of a mode at 433 nm involving BIC at $k = 0$.

[1] H. M. Doeleman et al. *Nature Photonics*, 12(7):397–401, Jul 2018.