Quality factor enhancement in low refractive index contrast subwavelength gratings

W. Głowadzka[1], **T. Czyszanowski**[1]

[1] *Institute of Physics, Lodz University of Technology, Wólczańska 217/221, Łódź, Poland*

Quality factor Q is an important feature necessary for many photonic devices, e.g. optical sensos, single photon sources or polariton excitation. Subwavelength Gratings (SGs) are known for its capabilities of obtaining infinite quality factor (called Bound States in Continuum) when the structure is vertically symmetric. A SG consists of infinite number of grating slabs arranged periodically made of high refractive index material submersed in low refractive index media. When the material at the top and bottom of subwavelength grating is the same, we refer to this structure as Vertically Symmetric (VC). Nonetheless, due to lack of mechanical stability it is preferable to disrupt this symmetry by placing SG onto stable material. In addition, for numerous applications where electrical pumping is necessary, good thermal and electrical conductivity is required, thus both subwavelength grating and substrate should be fabricated of semiconductor materials.

In [1] we showed that Bound States in Continuum (BICs) can be found in subwavelength gratings with refractive index contrast as small as 0.03. This proved to be possible to obtain high quality factor resonance inside infinite SGs made entirely of semiconductor materials. When the structure is finite quality factor decreases to $Q \approx 10^4$ for a membrane made of GaAs placed on AlAs substrate.

In this work we present 2 geometrical approaches of increasing quality factor, by modifying the central air gap and by modifying center grating slab.

[1] W. Głowadzka, M. Wasiak and T. Czyszanowski, *Nanoph.* **10**, 16 (2021).

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