One-dimensional topological interface states: a novel approach for optical pressure sensors

Jakob Lindenthal[1,2]
Anton Widulla[1], Johannes Benduhn[1], Karl Leo[1,2]
TU Dresden, Institute of Applied Physics, Nöthnitzer Str. 61, Dresden, Germany
ct.qmat Würzburg-Dresden Cluster of Excellence/University of Würzburg, Sanderring 2, Würzburg, Germany
jakob.lindenthal@tu-dresden.de

The research field of nano-optics in connection with topological photonics has quickly evolved over the past decades. Topological architecture in the design of photonic crystals enables disorder-protected interface states at crystal interfaces[1]. *The present contribution explores topological interface states in the context of pressure-sensitive nano-optical resonators*[2].
A novel, highly versatile pressure sensor concept is demonstrated, utilizing Zak phase inversion around a shared bandgap in one-dimensional photonic crystals to generate a pressure-sensitive interface state (thin film stack shown in Fig. 1A*). The use of an organic absorber molecule together with a topologically optimised electric field alignment is shown to provide pathways to significant force sensitivity enhancement of such systems (*Fig. 1B*). In the context of optical microcavities and interface states, systems supporting coupled photonic states*[3] *or modes are demonstrated as a promising architecture to provide additional sensing information*[4]. *The presented pressure-sensitive photonic crystal system may serve as a building block to support the design of ultra-compact optoelectronic pressure sensors.*

References

[1] Ling Lu, John D. Joannopoulos, Marin Soljačić, Nat. Photonics, 8 (2014), 821-829
[2] Jakob Lindenthal, Optoelectronic Pressure Sensing Utilising a One-Dimensional Topological Interface (master's thesis), TU Dresden (2022)
[3] Christoph Schmidt, Alexander Palatnik, Markas Sudzius, Stefan Meister, Karl Leo, Phys. Rev. B, 103 (2021), 085412
[4] Jakob Lindenthal, Anton Widulla, Johannes Benduhn, Karl Leo, One-dimensional topological interface states: a novel approach for optical pressure sensors (in preparation)

Figures

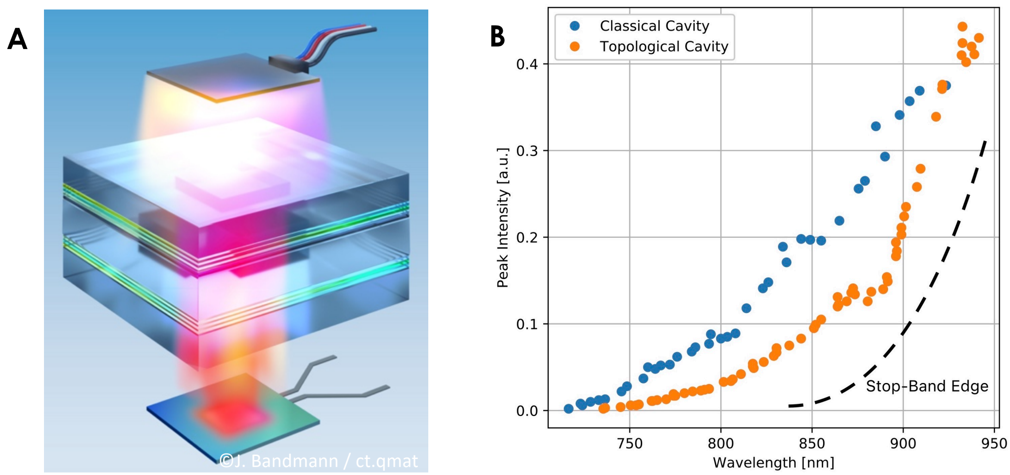

Figure 1: (**A**) Schematic illustration of a photonic crystal stack with a compressible cavity resonator. (**B**) Comparison of wavelength tuning in topological and trivial photonic crystal stacks under compression of the photonic crystal interface, steeper slope resulting from topology-induced enhanced absorption.