Perovskite Waveguides for Photonic Neural Networks

Barbara Piętka
University of Warsaw, Poland

Abstract— The development of tunable, room-temperature, and nonlinear photonic materials is key to advancing next-generation technologies such as optical neural networks, simulators, and sensors. I will present our recent demonstration of the room-temperature exciton-polariton neural network implemented in monocrystalline lead halide perovskite waveguides. By exploiting strong light-matter coupling and nonlinear polariton condensation, we realize scalable photonic neurons capable of performing machine-learning tasks, including binary classification and object recognition. This work overcomes the cryogenic limitations of previous polariton systems and establishes perovskite polaritons as a promising platform for ultrafast, energy-efficient optical computing and neuromorphic photonics.

Dr. hab. Barbara Piętka, Prof. UW, obtained her PhD degree from the University of Warsaw and Joseph Fourier University in Grenoble, France. She gained her professional experience working in France, Switzerland, and Germany. Since 2010, she has been affiliated with the Faculty of Physics at the University of Warsaw, where she founded and leads a research team focused on the study of non-equilibrium Bose-Einstein condensates of exciton-polaritons, quasiparticles resulting from strong light-matter interaction. Prof. Piętka is the co-author of over 70 peer-reviewed scientific articles published in prestigious international journals, including Nature Physics, Nature Materials, Physical Review Letters, Science, Laser and Photonics Review, and Optica. Prof. Piętka leads EU-funded EIC Pathfinder projects, represents Poland in the European Commission's Quantum Community Network, and is an active member of the Quantum Technology Cluster.

Barbara Piętka's scientific interests focus on quantum phenomena in nonlinear optical materials. Her work centers on research on semiconductors, layered materials, and perovskites in optical cavities. She seeks efficient solutions for room-temperature quantum information processing, particularly in the context of photonic accelerators, quantum optical neural networks, and modern computing systems. In addition to her research activities, she is actively involved in teaching, delivering lectures and workshops that inspire critical thinking and the exploration of new technologies.