

UNIVERSITY OF ŽILINA
Faculty of Electrical Engineering
and Information Technology

OPTOLAB

INVITATION

to a lecture

as part of a cycle

Trends in fibre and integrated optics



Pavel Cheben - National Research Council Canada

**Metamaterial engineered devices
and their key role in integrated photonics**



April 18, 2023 at 14.30 h.

Department of Multimedia and Information
and Communication Technologies
BC304



SLOVAK RESEARCH
AND DEVELOPMENT
AGENCY

The lecture series takes place in
the framework of the projects
APVV-21-0217, VEGA 1/0113/22 and UNIZA grants

INVITATION TO A LECTURE

METAMATERIAL ENGINEERED DEVICES AND THEIR KEY ROLE IN INTEGRATED PHOTONICS

April 18, 2023 at 14.30 h. - BC 304

Since the first demonstrations of a metamaterial silicon waveguide at the National Research Council of Canada [1], metamaterial waveguides have been explored extensively for controlling light propagation in planar waveguide circuits [2]. The integration of metamaterials on silicon chip allowed creation of integrated photonic devices with unprecedented control of refractive index, modal confinement, birefringence, anisotropy, dispersions and nonlinear properties. It also enabled highly efficient and robust coupling between photonic chips and external devices with efficiency approaching 100%. Metamaterial engineering has been adopted by silicon photonics industry and is now an integral design tool in integrated photonics with new applications advancing rapidly, including optical communications, biomedical, quantum and sensing technologies. Here we present an overview of recent advances in this surging field and discuss how optical metamaterials enhance the performance of the integrated photonic devices, including their key role in silicon photonics.

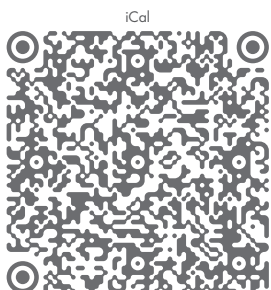
[1] P. Cheben et al., *Opt. Express*, vol. 14, 4695 (2006).
[2] P. Cheben et al., *Nature*, vol. 560, 565 (2018).



Pavel Cheben
National Research Council Canada

Pavel Cheben is a Principal Research Officer at the National Research Council (NRC) of Canada. He is also a Guest Professor at University of Zilina, an Honorary Professor at University of Malaga, and an Adjunct Professor at University of Ottawa, University of Toronto, Carleton University and McMaster University. Cheben is best known for his work in subwavelength metamaterial silicon photonic. He introduced a new area of research that brings together metamaterial technology and integrated photonics. For decades, a major hurdle in silicon photonics was a restricted number of silicon-compatible materials, insufficient to achieve complex optical on-chip functions. Cheben resolved this fundamental limitation by making a metamaterial – nanostructured material with engineered optical properties – directly on a silicon chip. This is recognized as one of the key discoveries in integrated optics in the past decades. His nanophotonic fiber-chip coupler holds the world record in coupling efficiency, polarization performance and bandwidth, and it has been adopted by major industry players, including IBM and GlobalFoundries (USA) for fibre-chip coupling in volume optoelectronic chip manufacturing. Cheben and collaborators also proposed the first silicon echelle grating wavelength multiplexer, which was adopted by Intel in its high-speed photonic transceiver product for data center interconnects. Cheben has co-authored more than 700 papers and book chapters, 40 patent applications and over 300 invited presentations, gaining more than 14,000 citations and H-factor 65 (Google Scholar). For pioneering research in several

fields, Cheben was elected to Fellow of the Royal Society of Canada, the American Physical Society, the Optica – Optical Society of America, the European Optical Society, the Institute of Physics (London), the Institute of Electrical and Electronics Engineers (IEEE), the Canadian Academy of Engineering, the Engineering Institute of Canada, and the International Society for Optics and Photonics (SPIE). The President of Slovakia invested him with the Pribina's Cross of the 1st degree, and the Slovak Academy of Sciences awarded him the International Prize, the Academy's highest honour. He is also the recipient of the Government of Canada's Public Service Excellence Award, the NRC Research Excellence Award – the Council's highest recognition of research excellence, the NRC Industrial Achievement Award, and an honorary degree doctor honoris causa by University of Zilina. He is the most published scientist of the NRC Canada for the past 15 years.



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