Center of Excellence in Micro and Nano Photonics- Laboratory of Micro and Nano Photonics, IMT-Bucharest

The Laboratory of Micro/Nano Photonics is recognized at national level, and funded between 2001 and 2004, as a **Centre of Excellence in Micro and Nano - Photonics.**

• Main areas of expertise

- modelling and simulation of micro and nano photonic structures ;
- new materials for micro/nano opto-electro-mechanical systems integration (e.g. compound semiconductors, functional polymer, hybrid organic-inorganic nano-compozites and glasses), and related fabrication processes (including mixed technologies);
- passive and active micro-nano-photonic structures for integrating in MOEMS for bio-medical and environment applications.
- hybrid or monolithic integrated photonic circuits and optical-MEMS (including heterogeneous platforms) for optical communications, interconnects and optical signal processing;
- Optical and electrical characterization of materials and optoelectronic and photonic components.

• Specific facilities:

Modelling and simulation: Finite-Difference Time-Domain (FDTD) simulation and design software Opti FDTD 6.0, waweguide optics design software OptiBPM 8.1, software for design and modelling of of active devices based on semiconductor heterostructures (Opti-HS); integrated and fiber optical gratings design software (OptiGrating); software for active device simulation (including transport, thermal and optical properties) - LaserMod.

Characterization: spectrophotometers for UV-VIS-NIR and IR spectral range; spectroscopic ellipsometer for materials characterization; experimental set-up for characterisation in UV-VIS-IR spectral range of optoelectronic and photonic components, circuits.

New: Research and High Resolution Raman Spectrometers LabRAM HR. High resolution confocal Raman microscope, offers unique spectral resolution and sensitivity on a bench-top microscope system.

Applications: microscopy and analysis into semiconductors, nano-materials, polymers.

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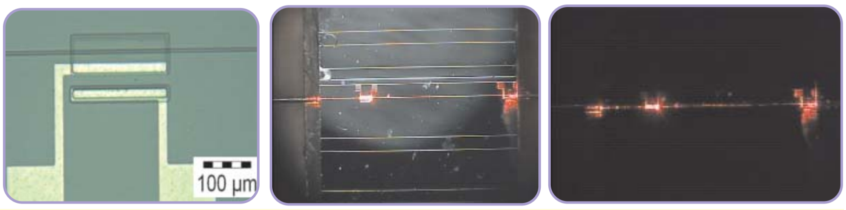
INTEGRATED BIOPHOTONICS POLYMER CHIP



7.5 µm wide straight WG leacky-wave coupled with a Si photodiode, optical images and light propagation

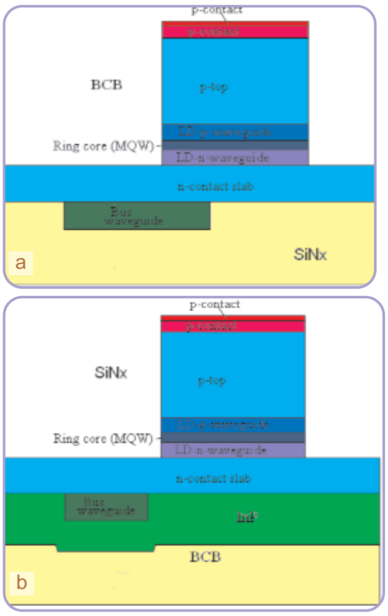
The goal of this project is to analyse the possibility of realizing compact biophotonic sensors for living cells by heterogeneous integration of optical waveguides, photo-detectors and electronics within a polymer microfluidic chip.

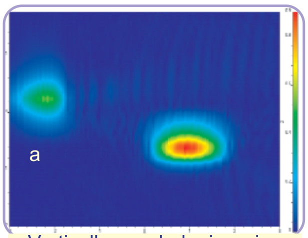
Preliminary results: heterogeneous integration of PMMA waveguides with silicon photodiodes.

Joint research in the frame of the FP6 NoE MULTI-MATERIAL MICRO MANUFACTURE: Technologies and Applications (4M); Co-operation with Institute for Microstructure Technology (IMT), Forschungszentrum Karlsruhe (FZK), Germany

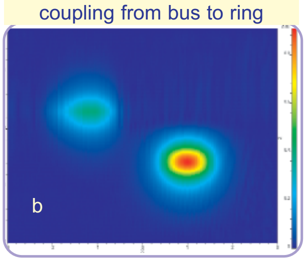
WAFERBONDING AND ACTIVE PASSIVE INTEGRATION TECHNOLOGY AND IMPLEMENTATION

Acronym: (**WAPITI**) Instrument: STREP FP 6, IST, *Coordinator* - Fraunhofer Institute for Telecommunications, Heinrich Hertz-Institut, Berlin, Germany; Dr. **Helmut Heidrich** (Helmut.Heidrich@hhi.fraunhofer.de).





Vertically coupled micro-ring resonator -configuration I. a) structure; b) radiation coupling from bus to ring



Vertically coupled micro-ring resonator -configuration II: a) structure; b) Radiation coupling from bus to ring

Recently, optical micro-ring resonators have received considerable attention since they provide a promising route towards very large-scale-integrated photonics. The key WAPITI structure for the miniaturisation of the optoelectronic GaInAsP/InP laser circuits is the active microring resonator which is vertically coupled to one or two transparent bus waveguides. Major advantages associated are compactness of the ring cavity (diameter of a few 10 µm), the realisation of ultra short couplers (order of 10 µm), precise control of the coupling strength with epitaxial growth accuracy, flexibility in the optimum choice of the material composition and pattern of the passive and active waveguides (optical I/O ports are located in a passive, transparent optical waveguide layer vertically coupled to an active, highly confined second waveguide layer in which microring cavities are formed).

Two configurations for of the active devices (ring lasers and wavelength converters) have been studied. The ring and bus waveguides are based on the InGaAsP material system with bandgap wavelengths smaller than 1550 nm , typically in the range from 1300 to 1400 nm. The two waveguides are grown on different substrates which are subsequently bonded to produce the micro-ring structure. All InP/GaInAsP epitaxial layers necessary for the fabrication of microring resonator devices are fabricated in a single epitaxial growth step on InP substrates.

We calculated the bus-ring and the ring-bus coupling efficiency as a function of the lateral offset necessary for optimal working properties. Our theoretical and numerical results were confirmed by the experiments done upon the passive ring resonators realized by WAPITI consortium.

The publication of this page is supported by the ***ROMNET-ERA*** project (EC Contract No 510475)