

# How optics and photonics address Europe's challenges of the 21<sup>st</sup> century



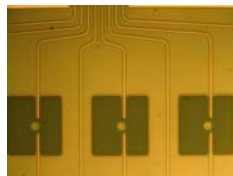
## Perfect silicon solutions

### Heterogeneous InP on silicon technology for optical routing and logic

HISTORIC focuses on digital photonic integrated circuits containing active and passive photonic elements for all-optical packet switching. The building blocks are ultra-compact gates based on micro-disk lasers and photonic crystal lasers, fabricated using heterogeneous integration of InP membranes on top of silicon on insulator (SOI) passive optical circuits. We use high precision growth and processing techniques available to the InP platform, and take advantage of the extreme accuracy of CMOS processing. Several all-optical flip-flops and gates are integrated on a single chip, and are interconnected by

short SOI waveguides. The extreme dimensions of the flip-flops, gates and their interconnections result in competitive footprint, speed and power consumption. The ultra small dimensions of the all-optical flip-flops result in record low switching times ( $< 60$  ps) and switching energies ( $< 2$  fJ). The unique features of the lasers can also be exploited for other optical signal processing, e.g. wavelength conversion for contention resolution. The possibility of integrating a large number of photonic digital units opens new perspectives for all-optical signal processing and optical buffers. The project therefore also focuses on designing relevant new optical switching and routing architectures. System tests will demonstrate the advantage of the new optical approach for processing and buffering over the conventional electronic approach.

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## It all starts with the fibre

### PHOSFOS - Photonic skins for optical sensing

PHOSFOS develops a flexible and stretchable foil that integrates optical sensing elements. The photonic skins find applications in continuously monitoring the integrity and the behaviour of different kinds of civil engineering structures and energy production facilities. PHOSFOS thereby contributes to safety of the public and personnel. The highly flexible skins will also serve long term monitoring of respiration and cardiac activity. PHOSFOS will therefore also contribute to better healthcare. The sensing elements rely on highly birefringent micro-structured optical fibres and on polymer optical fibres, both with

fibre Bragg gratings. The silica fibres exhibit almost zero temperature sensitivity to cope with the traditional temperature cross-sensitivity issues of conventional fibre sensors. Polymer fibres are used for their very specific property that their length can be stretched up to 300% before breaking. Two SMEs participate in PHOSFOS. The first SME, active in the field of structural health monitoring, forecasts a commercial revenue of 125 kEURO after five years. The second SME, active in healthcare, forecasts total income to rise to 2.1 MEURO after 9 years. PHOSFOS tackles essential issues such as packaging and fully-fledged system integration to support wide deployment of optical fibre sensor technologies. Together with the expected revenues, this will strengthen the competitiveness of European

industry in this field and ensure job creation in the involved SMEs.

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