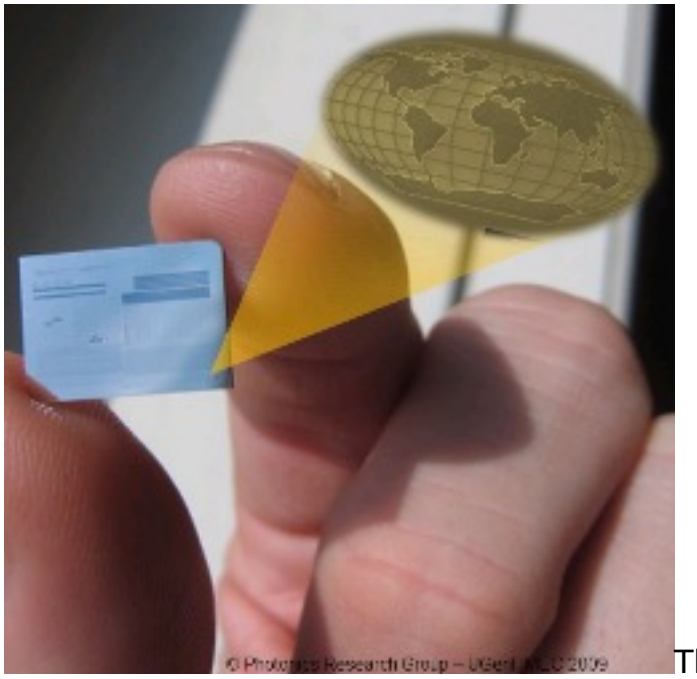
Researchers Fabricate Picoscale World Map



The Photonics Research Group of Ghent University-IMEC has fabricated a world map on a scale of 1 trillionth. Using CMOS fabrication tools, IMEC has reduced the 40-thousand-kilometer circumference at the equator down to 40 micrometer, about half the width of a human hair. The map is put in a corner of a optical silicon chip designed for one of the group's research projects on nanophotonic integrated circuits. The scale reduction enables more complex optical functions on a single chip for applications in telecommunication, high-speed computing, biotechnology and health-care.

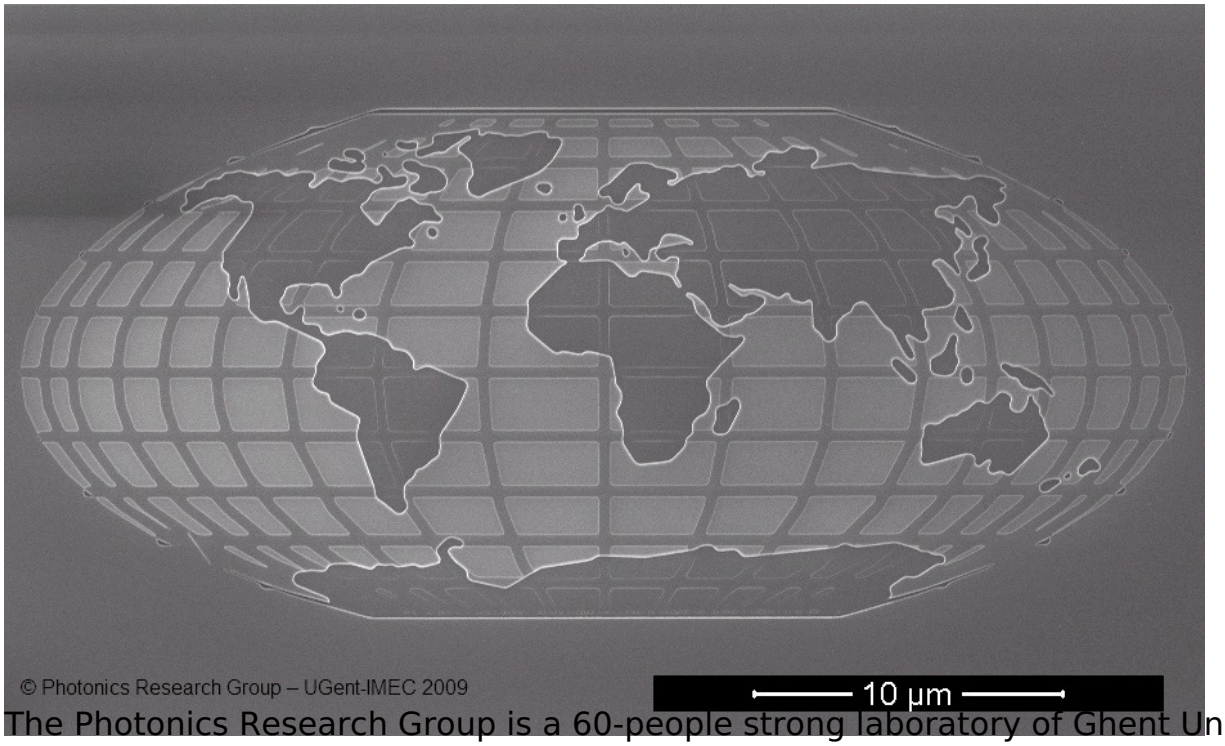
- The world map was defined on a silicon photonics test chip in IMEC’s clean-room for 200mm processing, using the same high-resolution optical lithography techniques as used for microelectronics fabrication, and the fabrication consisted of a 30-step process including layer depositions and chemical etching steps on a silicon-on-insulator wafer. Four different layer thicknesses can be resolved, corresponding to four different images, or mask layers, that have to be patterned separately. The tiny world map was piggy-backed onto a test and development chip for new nanophotonic circuitry.

- The silicon photonics technology that is being developed with these chips integrates optical circuits onto a small chip: Light can be manipulated on submicrometer scale in tiny strips of silicon called *waveguides* or *photonic wires*. Using the unique properties of silicon, combined with state-of-the-art

manufacturing technology, these silicon photonic circuits can pack a million times more components on the same footprint as today's commercial glass-based photonics.

- The circuits developed on this particular chip were used to demonstrate photonic wires with the lowest propagation losses. Also, structures were developed to improve the efficiency of coupling light from the outside world (like an optical fiber) to the wires on chip.

- To put it in perspective, the smallest features resolved on the map are about 100 nanometer (corresponding to 100km).



The Photonics Research Group is a 60-people strong laboratory of Ghent University (Ghent, Belgium) and is associated with the Interuniversity Microelectronics Center (IMEC), located in Leuven, Belgium. The group focuses on the research and development of smart photonic chips for future application in communications, identification, biosciences and health care, building on technologies developed for the microelectronics industry. The use of silicon and microelectronics fabrication can drastically reduce the size, power consumption and cost of photonic chips, bringing them closer to integration with consumer electronics, cell-phones as well as smart distributed sensor networks and point-of-care diagnostics.

Photonics group: photonics.intec.ugent.be [1]
Ghent University: www.ugent.be [2]
IMEC: www.imec.be [3]

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