PROGRAMMABLE INTEGRATED OPTICAL CIRCUITS USING THE OPEN-ACCESS CORNERSTONE PLATFORM

C. G. Littlejohns[1], D. T. Tran[1], H. Du[1], X. Yan[1], M. Banakar[1], X. Yu[1], X. Chen[1], M. Milosevic[1], G. De Paoli[1], M. Sorel[2], H. M. H. Chong[1], S. Saito[1], F. Y. Gardes[1], D. J. Thomson[1], G. Z. Mashanovich[1], and G. T. Reed[1]

[1]Optoelectronics Research Centre, University of Southampton, UK
[2]School of Engineering, University of Glasgow, UK

www.cornerstone.sotonfab.co.uk

cornerstone@soton.ac.uk

1. TRIMMING OF SILICON PHOTONICS DEVICES

Some silicon photonics devices, typically resonant devices, are extremely sensitive to unavoidable fabrication errors. Traditionally, the phase errors introduced by the fabrication tolerances are corrected using heaters that exploit the high thermo-optic coefficient of silicon. This approach is very inefficient since it relies on continuous power dissipation to drive the heater.

We have developed a novel process whereby we can permanently correct fabrication errors through the use of ion implantation of a heavy ion to selectively amorphize a region of the resonant device, followed by a laser annealing step to recrystallize a given area of the amorphous region.

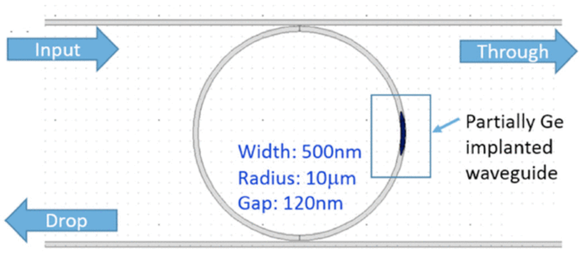


Fig. 1. Diagram of partially implanted ring resonator

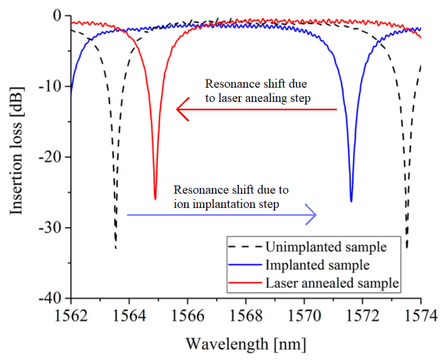


Fig. 2. Spectral responses for ring resonators at various stages of the trimming process

2. PROGRAMMABLE SILICON PHOTONICS CIRCUITS

Developing this concept further, we have demonstrated the ability to remove the ion implantation damage using an electrically controlled heater, which enables the annealing process to be utilized even after final device packaging.

By incorporating implanted waveguides into a Mach-Zehnder Interferometer (MZI) acting as an optical switch, we can now electrically switch the optical mode from the drop port to the through port without the requirement to continuously heat (and therefore continuously consume power) one arm of the MZI, as is common in typical programmable optical circuits.

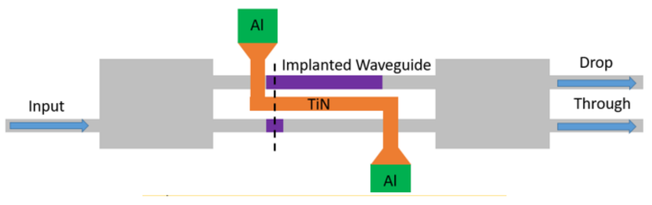


Fig. 3. Programmable MZI switch design

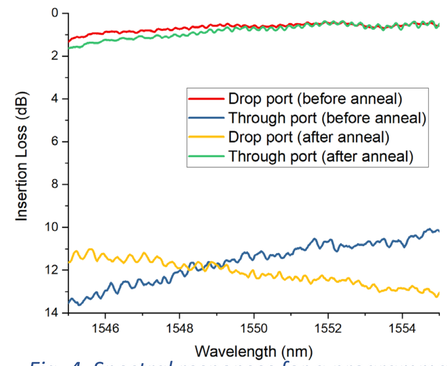
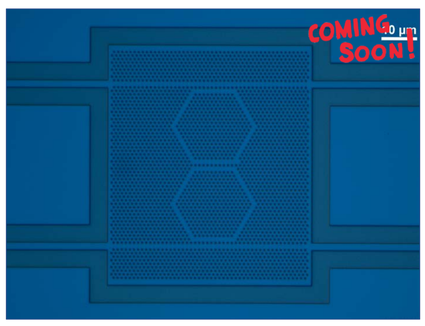
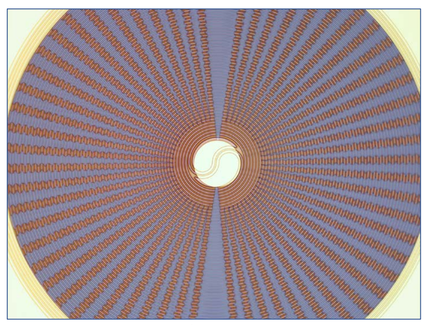


Fig. 4. Spectral responses for a programmable MZI switch

OPEN-ACCESS TECHNOLOGY PLATFORMS

Silicon nitride

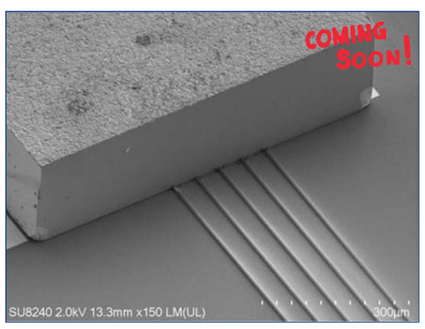




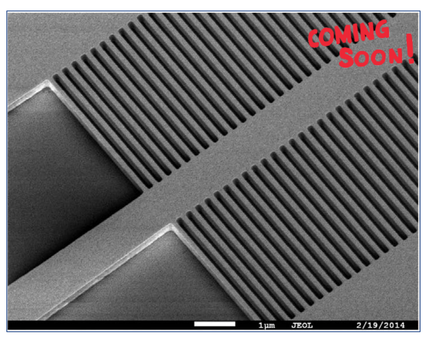
Silicon-on-insulator

PDK AVAILABLE

Pick-and-place of light sources

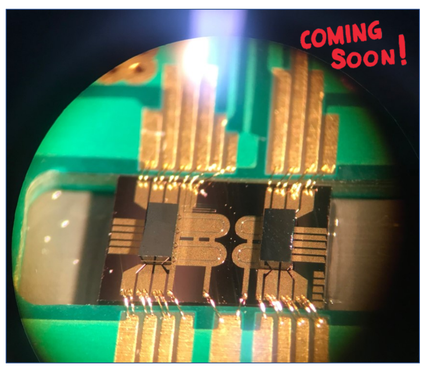


CORNERSTONE

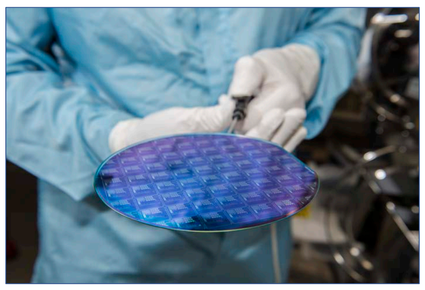


Suspended silicon

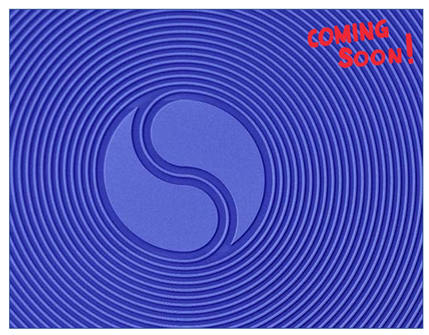
Flip-chip bonding



THE WORLD'S ONLY OPEN-ACCESS SILICON PHOTONICS FOUNDRY



DUV projection lithography



Germanium-on-silicon

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