Angled MMI CWDM structure on Germanium on Silicon

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There are several examples of angled multimode intereferometers (AMMI) [1, 2], arrayed waveguide gratings (AWGs) [3] and echelle gratings/planar concave gratings (PCGs) [4] in SOI, as these are the most widely used components for performing wavelength division multiplexing [5]. While the last two usually require an extra lithography step to improve insertion loss and crosstalk as well as a very fine control of the fabrication procedure to improve the spectral response, the AMMI requires a single lithography and etching step and it is more tolerant to fabrication errors. In this paper we demonstrate the first AMMI fabricated in the germanium-on-silicon material platform.

The device was fabricated on 1.75μm thick germanium on silicon with a 60nm SiO_2 overlayer. This material has already been used for AWGs and PCGs designs [6]. The AMMI dimensions were 50μm width by 10mm length for the multimode region, 14μm width for the input and output tapers and 0.28rad angle between the tapers and the multimode region. The rib waveguides were 2.1μm wide. The patterns were defined in ZEP-520A resist by e-beam lithography and inductively coupled plasma (ICP) by 1.15μm.

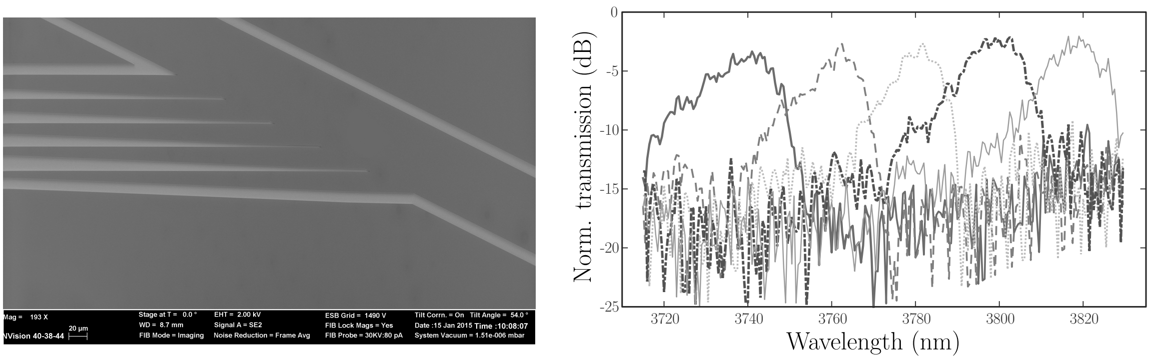

Fig. 1: Left SEM image of the output section of the 5-channel AMMI, right measured output the 5-channels.

The waveguide propagation loss was measured as being $1.4 \pm 0.24\text{dB/cm}$, at wavelengths between 3.715μm and 3.835μm, applying the effective cut-back method where transmission through waveguides of different lengths was measured. Light was coupled from a quantum cascade laser via surface grating couplers fabricated in Ge. The measurements for the AMMI revealed approximately 3dB insertion loss, -10dB crosstalk and 20nm channel spacing (Fig.1b). We suspect that the noise floor is artificially reducing the crosstalk. Improved grating couplers should address this issue. Simulations suggest that the insertion loss and the channel spacing could also be decreased by increasing the Ge thickness.

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