fabricated for comparison, with waveguides and tapers identical to those used for the implanted structures. A period of 700nm and an etch depth of 70nm were used. The most efficient surface relief grating coupler and taper combination exhibited a coupling loss of 4.5dB which is comparable to the best amorphous silicon grating coupler with taper structure of 5.5dB, as shown in Fig. 5.

The 1dB and 3dB bandwidth of the implanted devices are 32nm and 56nm respectively. The corresponding bandwidths of the surface relief gratings fabricated alongside the implanted versions were measured to be 30nm and 51nm respectively, which is comparable to uniform surface relief gratings published in the literature [15, 35].

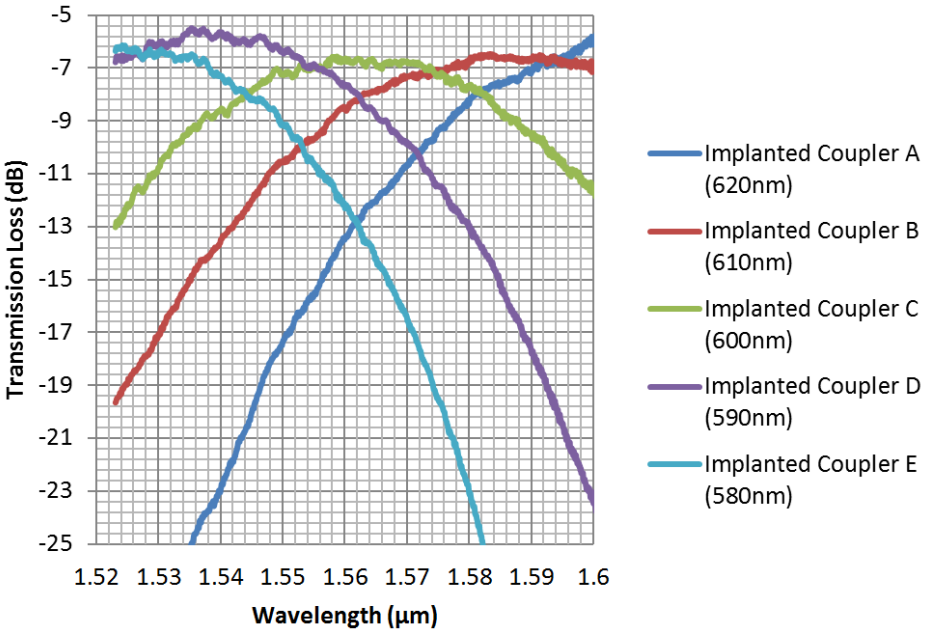

Fig. 5. Performance of implanted grating couplers at different central wavelengths.

The implanted structures perform comparably with surface relief gratings as expected. The Δn of 0.48 introduced by the amorphous to crystalline interface is considerably lower than that of the silicon to air, or silicon to silicon dioxide, with Δn of 2.48 and 1.95 respectively. A lower index contrast reduces coupling strength, to compensate for this, the amorphous region is almost twice as deep as the comparable etched region, maximising the effective index contrast. This results in the performance of the implanted coupler being only 1dB lower than the surface relief counterpart.

6. Conclusions

In this paper a novel method of fabrication has been demonstrated for diffractive grating couplers which allow the surface planarity of silicon waveguide devices to be maintained whilst still providing comparable coupling efficiency between a silicon wire waveguide and a single mode optical fibre, as compared to a surface relief grating. The effective index modulation introduced via ion implantation forms an amorphous allotrope of silicon using lattice disorder.

The coupling loss for an implanted grating and taper combination shows a performance reduction of only 1dB compared with its etched counterpart and the 1dB and 3 dB bandwidths are also shown to be comparable to those of surface relief gratings.

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