Heterogeneously integrated III-V/Si lasers based on DVS-BCB bonding

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The main interest in silicon-based photonic stems mostly from the expectation that the maturity and low cost of CMOS-technology can be applied for advanced photonics products. Other driving forces for silicon photonics include the design richness associated with high refractive index contrast as well as the potential for integration of photonics with electronics. Building light sources, and in particular laser sources, on integrated silicon circuits is a long sought goal, on one hand in order to complete the functionality of the integrated circuit with one or several light sources but on the other hand also as a manufacturing approach for lasers on large wafers in CMOS-fabs. The most successful approach to date is definitely the hybrid (also called heterogeneous) III-V on silicon laser. Two main technologies are used to heterogeneously integrate III-V epitaxial layer stacks on a silicon waveguide circuit: molecular bonding and adhesive bonding. In the Photonics Research Group – Ghent University / Imec, we focus on adhesive die-to-wafer and wafer-to-wafer processes, based on DVS-BCB as a bonding agent, given the relaxed requirements on the III-V wafer surface quality. In these approaches, unstructured InP-based dies are bonded, epitaxial layers down, on an SOI waveguide circuit wafer, after which the InP growth substrate is removed and the III–V epitaxial film is processed. The laser cavity gets its gain from the III-V layers but couples its output light into a silicon waveguide. Often part of the cavity structure is implemented by means of patterning in silicon, thereby taking advantage of the resolution and accuracy of lithography tools in CMOS fabs. In the recent years a lot of progress has been made in the field of hybrid silicon lasers, in particular with respect to the type of the cavity, the type of light coupling between the silicon layer and degree of the light confinement in the gain layer. In this presentation we will outline our work on the integration of III-V laser sources on a silicon waveguide platform.