Hybrid III-V Photonic Crystal wire cavity Laser on Silicon Wire

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Abstract

We report laser emission from hybrid III-V nanocavities on silicon on insulator waveguide. As the cavity is optically pumped by the surface, laser emission is coupled into the SOI wire and collected at its output.

Small volume cavities based on a periodic line of holes in a waveguide (wire cavities) are being extensively studied both theoretically and experimentally for the high Q/V factor they offer[1]. So far a lot of attention has been devoted to passive structures and incorporating an active element has not been explored yet, though it is an exciting possibility as the strong light confinement promises ultra-small lasers with low laser thresholds. Making them CMOS compatible would open up myriads of applications. For this, the most efficient way would be to combine III-V active elements and low-loss passive silicon photonic circuitry drawing benefit from the technological advancement in both material systems. In this work, we report laser emission obtained at 1.55µm from InP-based wire cavity heterogeneously integrated to silicon on insultalator wavguides. T he sample is depicted in Fig. 1a, the lower level is composed of narrow Si waveguides (~500nm wide and ~220nm high) where the light propagates passively, and the top layer is the active InP-based wire cavity. Silicon waveguides are fabricated in a CMOS fab using 193nm DUV lithography on SOI. The InP heterostucture is grown by MOCVD and the wire cavity obtained through electron beam lithography followed by plasma etching. Details on the fabrication may be found in [2]. The samples are optically surface-pumped by a pulsed 800nm diode laser at repetition rate of 300kHz with a 2% duty cycle. The emission is detected simultaneously, from the surface of the wire cavity and at the output of the SOI wire. The results of the measurements are shown Fig. 1b. As the design of the cavity is optimised for guided mode emission and we measured a guided emission that is a factor of three higher than the vertical emission.

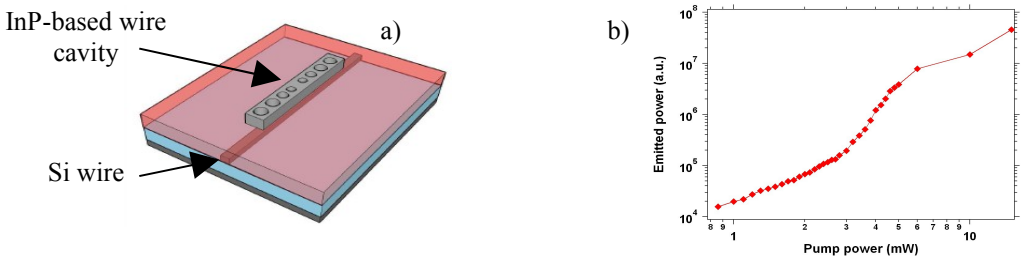

Fig.1 a) Schematics of the studied sample. b) Emitted power versus pump power.

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References

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