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Photonic crystal circular defect (CirD) laser

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By the analogy of Inter-chips optical interconnections, the target density for Intra-chip optical interconnections is estimated to be 10 Pbps/cm2 [1]. This value may not be possible by Si-photonics anymore, because its target density is 10 Tbps/cm2. The authors have proposed a solution by using 2 dimensional photonic crystal (PC) [1]. The laser-cavity is a circular defect (CirD) in the PC lattice. Only a whispering galley mode (WGM) with 9 wavelengths can stably exist there, because the cavity is surrounded by 18 air holes. The light in the cavity is outputted through the line-defect waveguide which is optically coupled with the cavity as shown in Fig. 1. The lasing wavelength in each cavity can be varied by changing the radius of the circular cavity. When cavities with different lasing wavelengths are placed near an output waveguide, the wavelength division multiplex (WDM) transmission system can be realized without a conventional optical multiplexer. Each laser can operate at a speed of above 50 Gbps, hopefully 100 Gbps due to small cavity volume. Therefore, the WDM transmission system with 10-20 channels results in transmission capacity of 1 Tbps. Since footprint of the proposed light source is 100 m square, the density of 10 Pbps/cm2 can be realized. We prepared an epi-wafer shown in Fig. 1 in order to experimentally confirm lasing of WGM in CirD cavities by optical pumping. Air holes to form CirD cavities and an output waveguide were fabricated by electron beam lithography and dry etching. Contentious wave (CW) pumping light with wavelength of 785 nm was irradiated onto the CirD cavity. Light output through the waveguide was measured at room temperature (RT). Threshold power was about 25 W. The spectrum of a cavity was obtained through the waveguide. A single longitudinal mode operation under RT-CW conditions was confirmed.

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