Perovskite On-Chip Lasers for Photonic Integrated Circuits

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An on-chip laser that can be monolithically integrated into silicon substrates is the final missing component for integrated photonics, the applications of which span from telecommunication [1] to retinal projection systems [2]. Metal-halide perovskites are semiconductors gaining momentum as laser gain materials as they can be deposited on silicon or amorphous substrates by low-cost, low-temperature methods such as spin coating [3]. These materials are ionic crystals and therefore are incompatible with standard patterning methods used by semiconductor based on photolithography.
We have developed such photolithography-based process and used it to fabricate perovskite disc lasers (Fig. 1a-b). These devices have the lowest lasing threshold of 4.7 μJcm^{-2} ever reported for any monolithically integrated laser compatible with back-end-of-line of CMOS [4]. When pumped with femtosecond pulses multiple modes are lasing in the discs, even at an excitation slightly above the lasing threshold. When pumped with 700 ps long pulses, which are much longer than stimulated emission lifetime of 20 ps, the lasers work in a quasi-steady-state and show a single mode operation (Fig. 2). The measured output intensity vs. excitation curve can be fitted with the rate equation for semiconductor lasers [5].

REFERENCES

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FIGURES

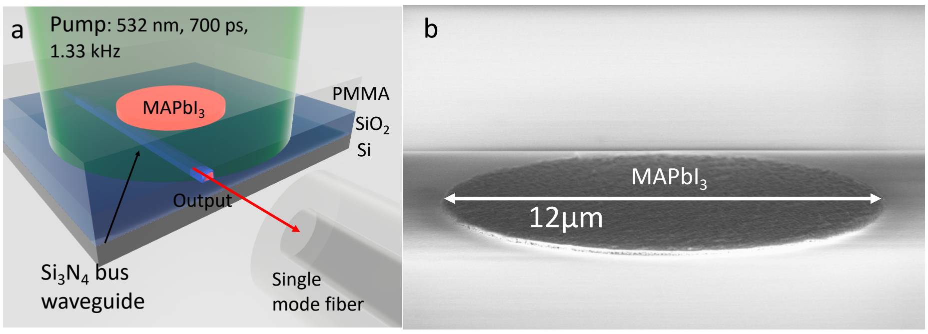

Figure 1: a) Schematic of optically pumped perovskite waveguide integrated disc later b) SEM image of top-down patterned perovskite disc

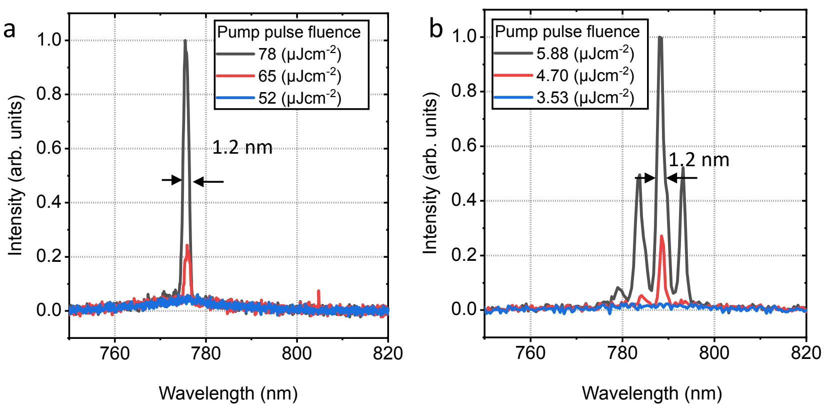

Figure 2: a) Laser spectrum obtained by pumping with 700 ps pulses at 532 nm wavelength b) Laser spectrum obtained by pumping with 120 fs pulses at 630 nm wavelength