on-resonant lifetime shortening can be attributed to the onset of stimulated emission in the disk. In fact, the 4-level system in Nd ions enables population inversion with no absorption threshold and Nd ions have a larger stimulated emission cross section than Er [15]. These two factors make lifetime shortening easier to observe in Nd resonant cavities compared to Er-doped ones. However, despite our demonstration of stimulated emission in the system, the pump power dependence of the PL at the cavity modes still exhibits a sub-linear trend (data not shown here), implying that we have not yet achieved the micro-disk lasing regime due to the large sidewall roughness losses which limit the Q-factor of the disk. However, the observation of stimulated emission in Nd:SiN_x shows great promises for the engineering of on-chip lasers based on this novel materials platform.

4. Conclusions

In summary, Nd:SiN_x materials were fabricated and optimized in terms of PL intensity and emission lifetime. Similar to the case of Er:SiN_x, nanosecond-fast energy transfer from localized states in the bandgap of SiN_x to Nd ions was observed and the role of excess Si and Nd concentration in these films discussed. The effective Nd excitation cross section for the 4-level 1.1 μm transition was measured and an active Nd:SiN_x micro-disk was fabricated. Stimulated emission from the resonant modes of the disk was demonstrated under optical pumping. These results show that the Nd:SiN_x materials platform bears great promises for the fabrication of Si-based laser.

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