

Third-harmonic generation in 1-D photonic-crystal-based amorphous nanocavity

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The photonic crystals (PCs) and NPC-based nanocavities (NCs) are good candidates for integrated optical devices, such as nonlinear optical diodes [1], optical switching elements [2] and optical limiters [3]. Direct third harmonic generation with cubic susceptibility $\chi^{(3)}$ is difficult to achieve in bulk and homogeneous materials because of low $\chi^{(3)}$ and the strong natural dispersion. However, it can be easily generated in the band edges of PCs and the defect modes of NCs. In this work, large enhancement of one-step third-harmonic (TH) was generated in 1-D dielectric photonic-crystal-based amorphous nanocavity. The dielectric photonic crystal is fabricated using TiO_2 and SiO_2 , and the defect medium is amorphous LiNbO_3 . The intensity at the focussed pumped beam was about 127 GW/m^2 , which is lower than that used in other report (@ 500 GW/m^2) [4]. As shown in Fig.1, TH peaks are observed at the wavelength of 338 nm and 250 nm when the fundamental wavelength is tuned to the defect mode (1015 nm) and band edge (750 nm), respectively. The TH intensity at the defect mode is approximately ten times larger than that at the band edge, and achieves four orders of magnitude higher than that in the band gap. The TH intensity enhancement at the defect mode increases up to approximately five orders of magnitude compared with that of LiNbO_3 with the same thickness. This is attributed to field localization in the defect layer and adjacent region. The result shows that it is possible to generate third harmonics directly through resonant photon confinement in NC.

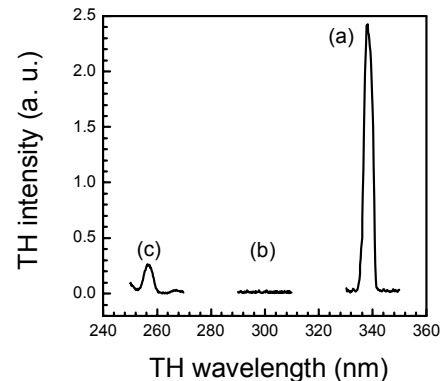


Figure. 1: The relative TH intensity when fundamental wave is adjacent to transmission peak (a), in band gap (b), or at band edge (c).

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