Chapter 29

Nonlinear Optics in TiO₂ Nanoscale Waveguides

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Abstract We propose polycrystalline anatase TiO₂ nanoscale waveguides as a platform for efficient, on-chip generation of triplet photons via third-order spontaneous parametric down-conversion (TOSPD). TiO₂ has a high nonlinear index of refraction ($0.16 \times 10^{18} \text{ m}^2/\text{W}$ at 1565 nm), a wide transparency window (absorption edge at 400 nm) and negligible two-photon absorption above 800 nm, making it an advantageous material for integrated photonics. Efficient generation of three-photon entanglement on an integrated platform is necessary for many experiments in quantum optics, with applications in quantum metrology and communication. We couple simulations to experiments to determine and confirm optimal waveguide geometries for meeting TOSPD phase-matching constraints and maximizing the efficiency of triplet-photon generation in TiO₂ nanoscale devices.

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