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Performance comparison of Zn-MOF and Nb₂CT_x/Co₃O₄ coatings on side-polished fibers for enhanced four-wave mixing at 1.5 μm

[Optical Fiber Technology](#) • Article • Open Access • 2026 • DOI: 10.1016/j.yofte.2026.104605

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Abstract

This study investigates the enhancement of the four-wave mixing (FWM) process in side-polished optical fibers (SPFs) operating in the 1.5-μm telecommunication band through functionalization with a Zinc-based Metal-Organic Framework (Zn-MOF) and Cobalt Oxide nanocomposite (Nb₂CT_x/Co₃O₄). The side-polishing technique creates a platform for intense evanescent-field interaction, significantly boosting local optical intensity and thereby strengthening the nonlinear response within a compact device footprint. The experimental setup employed two tunable continuous-wave laser sources as pump and signal inputs, which were combined and amplified before being launched into a side-polished fibre (SPF) composites onto the polished fiber surface yielded a substantial improvement in the nonlinear

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performance, with measured conversion efficiency enhancements of up to 16.0% compared to an uncoated SPF. A stability assessment conducted over 60 min confirmed the robust and consistent generation of the FWM idler. These findings underscore the potential of advanced-material-functionalized SPFs as efficient, compact nonlinear platforms for all-optical signal processing in the conventional telecommunication band. © 2026

Author keywords

1.5- μm wavelength; Four-wave mixing; $\text{Nb}_2\text{CT}_x/\text{Co}_3\text{O}_4$; Zn-MOF

Indexed keywords

Engineering controlled terms

Continuous wave lasers; Crystalline materials; Erbium doped fiber amplifiers; Niobium compounds; Optical fibers; Optical signal processing; Organometallics; Zinc compounds

Engineering uncontrolled terms

1.5- μm wavelength; Four-wave-mixing; Four-wave-mixing process; Metalorganic frameworks (MOFs); $\text{Nb}_2\text{CT}_x/\text{Co}_3\text{O}_4$; Performance comparison; Side-polished fiber; Side-polished optical fiber; Telecommunication bands; Zinc-based metal-organic framework

Engineering main heading

Four wave mixing

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Funding details

Details about financial support for research, including funding sources and grant numbers as provided in academic publications.

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Funding text

We thank Universiti Malaya for funding under the grant RU001-2025A and the financial support from United Arab Emirates University through the research grant fund 12 N144 .

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Abstract

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