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Temperature-Dependent Reflectometric Polymer Optical Fiber Sensor Based on a Thermally Fused PMMA Interface

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Abstract

A temperature-dependent reflectometric sensor based on a thermally fused polymethyl methacrylate (PMMA) polymer optical fiber (POF) is experimentally demonstrated. A localized fused region was formed by controlled thermal processing at 350°C, producing an intrinsic reflective discontinuity within the fiber without incorporating gratings, interferometric cavities, or external coatings. The device was characterized over the temperature range of 30 °C–80 °C. The fused region exhibited a linear and monotonic spectral response under both coherent laser and broadband illumination. Maximum sensitivities of 0.0626%/°C (laser interrogation) and 0.0581%/°C (broadband excitation) were obtained, with regression coefficients up to 0.99, confirming stable and predictable thermo-optical behavior. The temperature-dependent bandgap variation, on the order of 10⁻⁴ eV/°C, further confirmed consistency between intensity modulation and intrinsic material response. The correlated evolution of reflection and bandgap energy establishes a direct link between microstructural modification and sensing response. The results indicate that a thermally fused PMMA interface can function as a stable, broadband reflectometric temperature sensor with simple fabrication and intrinsic structural robustness, offering an alternative to wavelength-selective polymer fiber sensing configurations. © 2001-2012 IEEE.

Author keywords

Bandgap analysis; polymer optical fiber (POF) sensor; temperature sensor; thermally fused interface

Indexed keywords

Engineering controlled terms

Fiber optic sensors; Interfaces (materials); Interferometry; Optical fiber fabrication; Plastic optical fibers; Reflective coatings

Engineering uncontrolled terms

Bandgap analyze; Interferometric cavity; Localised; Methacrylate polymers; Polymer optical fiber sensors; Polymer optical fibre; Temperature dependent; Temperature range; Thermal; Thermally fused interface

Engineering main heading

Temperature sensors

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