Free spectral range analysis of double series microresonator system for all-optical corrosion sensor

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Abstract

A double series configuration of a microresonator is proposed to measure the amount of corrosion on iron metal. A numerical computation has been performed for analyzing the sensing operation in which the metal is attached to the waveguide as a top cladding material. The transparency peak profile and transfer function of the output transmission spectrum is obtained using a signal flow graph method and Mason's rule. The output spectrum of the microresonator shows that the linear free spectral range (FSR) changes as the iron begins to oxidize, which affects the cladding index of the sensing system. The FSR changes with respect to the amount of corrosion present in iron metal. In addition, the microresonator is able to distinguish two different types of corrosion, which are hematite and magnetite. The sensitivities of the practical application design are obtained as 22.62 nm/RIU for magnetite and 7.17 nm/RIU for hematite detection. The FSR analysis is an alternative approach in all-optical sensing to wavelength shift. It is promising for applications in additional high-sensitivity all-optical corrosion sensors. (C) 2020 Society of Photo-Optical Instrumentation Engineers (SPIE)

Keywords

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