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Authors: Mateusz Śmietana, Predrag Mikulic, Wojtek J. Bock

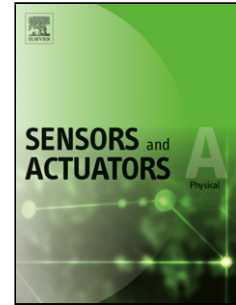
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Nano-coated long-period gratings for detection of sub-nanometric changes in thin-film thickness

Mateusz Śmietana,^{a,*} Predrag Mikulic,^b Wojtek J. Bock^b

^a Institute of Microelectronics and Optoelectronics, Warsaw University of Technology, Koszykowa 75, Warsaw, Poland

^b Centre de recherche en photonique, Université du Québec en Outaouais, 101 rue Saint-Jean-Bosco, Gatineau, QC J8X 3X7, Canada

m.smietana@elka.pw.edu.pl, pmikulic@uqo.ca, wojtek.bock@uqo.ca

* Corresponding author: Mateusz Śmietana, Fax: +48 22 234 6063; Tel: +48 22 234 6364; E-mail: m.smietana@elka.pw.edu.pl

HIGHLIGHTS

- A sensor based on a long-period grating (LPG) with a high-refractive-index coating has been developed for use in detecting changes in thin-film thickness at the sub-nm level.
- The effect was predicted by numerical analysis and demonstrated experimentally for LPGs coated with aluminum-oxide (Al_2O_3) and then chemically etched in NaOH.
- When coated with Al_2O_3 , the sensitivity reaches a resonance wavelength shift of over 20 nm per single nm of change in thin-film thickness.
- The origins of this extraordinary sensitivity lie in LPG working conditions tuned up to simultaneously engage the dispersion turning point and the mode transition.

Abstract

This work presents an application of a long-period grating (LPG) for high-precision detection of changes in the thickness of thin films deposited on its surface. LPGs highly sensitive to the external refractive index and reference silicon (Si) wafers were nano-coated with a thin overlay of aluminum oxide (Al_2O_3) using the atomic layer deposition (ALD) method. Then both LPGs and wafers were exposed to two different concentrations (10 and 100 mM) of sodium hydroxide NaOH, a well-known etchant of Al_2O_3 . Transmission of the LPG was measured at different stages of the experiment for a fixed external refractive index (air or water) and the results were compared to reduction in Al_2O_3 thickness on reference Si wafers. It was found that the

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