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Review Article

Fiber Optic Chemical Nanosensors Based on Engineered Single-Walled Carbon Nanotubes

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Abstract

In this contribution, a review of the development of high-performance optochemical nanosensors based on the integration of carbon nanotubes with the optical fiber technology is presented. The paper first provide an overview of the amazing features of carbon nanotubes and their exploitation as highly adsorbent nanoscale materials for gas sensing applications. Successively, the attention is focused on the operating principle, fabrication, and characterization of fiber optic chemosensors in the Fabry-Perot type reflectometric configuration, realized by means of the deposition of a thin layer of single-walled carbon nanotubes (SWCNTs) upon the distal end of standard silica optical fibers. This is followed by an extensive review of the excellent sensing capabilities of the realized SWCNTs-based chemical nanosensors against volatile organic compounds and other pollutants in different environments (air and water) and operating conditions (room temperature and cryogenic temperatures). The experimental results reported here reveal that ppm and sub-ppm chemical detection limits, low response times, as well as fast and complete recovery of the sensor responses have been obtained in most of the investigated cases. This evidences the great potentialities of the proposed photonic nanosensors based on SWCNTs to be successfully employed for practical environmental monitoring applications both in liquid and vapor phase as well as for space. Furthermore, the use of novel SWCNTs-based composites as sensitive fiber coatings is proposed to enhance the sensing performance and to improve the adhesion of carbon nanotubes to the fiber surface. Finally, new advanced sensing configurations based on the use of hollow-core optical fibers coated and partially filled by carbon nanotubes are also presented.

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