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Sol-gel derived nanomaterials for designing fiber optic gas sensors

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Sol-gel methods and sol-gel combined with micelle techniques have been developed for synthesizing nanostructured materials, including porous silica, porous tin oxide, silver nanoparticles immobilized porous silica and palladium nanoparticles immobilized porous silica. These nanostructured materials have been used in the development of fiber optic gas sensors. The sol-gel derived porous silica has been coated on surface of optical fiber core for the development of a moisture sensor. Sol-gel derived tin oxide nanoparticles have been coated on surface of a silica optical fiber having a gold jacket for sensing reducing gases (H_2, CH_4, CO) at elevated temperatures (300-800°C). Silver nanoparticles have been immobilized in sol-gel derived porous silica by using a thiol stabilizer. The silver nanoparticle immobilized porous silica has been coated on surface of silica optical fiber core. The exposure of such a nanomaterial coating to an ammonia-containing gas sample causes a decrease of light intensity guided through the fiber, which can be used as a sensing signal for monitoring ammonia concentration in gas samples. Palladium nanoparticles have been synthesized by using a micelle technique with Triton X-100. The formed palladium nanoparticles have been immobilized to sol-gel derived silica. The palladium nanoparticle immobilized sol-gel silica has been made into the form of an optical fiber by using a patented fiber fabrication method. This porous fiber has been tested for sensing trace hydrogen gas in air for applications at ambient temperature. This paper reports the methodologies of making the above mentioned nanomaterials, the structure of the fiber optic sensors and test results of using the sensors for monitoring trace gases in different gas samples.

Biography

Shiquan Tao completed his PhD in chemistry from Hiroshima University, Japan. He is an Associate Professor of Chemistry at West Texas A&M University with research interest in the development of fiber optic chemical/biochemical sensors for monitoring industrial processes, environmental monitoring as well as for quick detecting food borne pathogens. Before joining the faculty at WTAMU, he was a research faculty at the Diagnostic Instrumentation and Analysis Laboratory of Mississippi State University in charge of the institute's fiber optic sensor research program for US DOE' Office of Science's Environmental Management Program.

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