Optical Fiber Sensor Based Smart Materials and Structures

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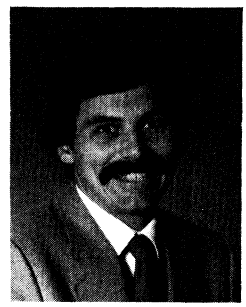
Optical fiber sensors have been applied to the characterization of materials and structures for more than a decade. Fiber sensors have been demonstrated for applications in monitoring (1) the fabrication conditions of advanced polymer-, metal-, and ceramic-based composite materials, (2) the in-service conditions of these materials and related structural components during their intended use lifetimes, and (3) the degradation and damage of such materials and structures. Although applications in aerospace, hydrospace, and civil engineering structures may be driving the use of such sensors at this time, applications in industrial control systems and consumer products seem possible in the future. Papers in this special section of *Optical Engineering* address several of the fiber sensor technology issues from markedly different technical perspectives.

Optical fiber sensors may be attached to or embedded within materials to evaluate their performance. In some cases, specialized optical fibers, having peculiar waveguide geometries or requiring novel materials, are necessary either to enable the sensing of the environmental phenomenon to be measured, or to permit operation at the maximum required strain or temperature conditions. In other cases, specific sensor geometries are needed to allow the quantitative measurement of strain, temperature, acoustic wave, vibrational, or other characteristics. The performance of the sensor systems in these cases is in part determined by the characteristics of the optical fiber waveguide to be used, the fiber sensor geometry, and the nature of the observable field to be measured.

The papers in this special section concern fiber sensor applications for the analysis of advanced materials and structures, and consider these fiber, materials, and systems issues. Fiber sensors may prove to be the sensors of choice for such uses, due to their wide range of application, their intrinsic avoidance of electromagnetic interference effects and ground loop problems, and their extreme sensitivities. Fiber optic sensor based smart materials and structures may be the springboard for the more advanced totally integrated, and partially optical, smart and reactive materials and structures of the future.



Richard O. Claus received BES and Ph.D. degrees in electrical engineering from the Johns Hopkins University in 1973 and 1977, respectively. Since 1977 he has been a member of the engineering faculty at Virginia Tech, although he has worked for brief periods of time at the NASA Langley Research Center and for ITT. His background and interests are in the areas of optical instrumentation and materials characterization. During the past fifteen years, he has authored or coauthored more than 200 journal and conference papers and 45 patent disclosures related in particular to optical fiber devices and sensors and their applications in materials evaluation and smart structures and materials. He is currently the director of the Fiber and Electro-Optics Research Center and is the Willis C. Worchester Professor of electrical engineering at Virginia Tech. Claus is a member of IEEE, SPIE, OSA, ASA, and SEM.