Faculty of Electrical Engineering & Computer Science
Master Degree Course Electronics Engineering, MSc EE

HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES

Master 2010

Ali Fahd

Integration of optical fiber sensors in plastic and Metal Injection Molding (MIM) components

ABSTRACT - Masterthesis

In the recent years optical fibers have made an enormous impact on modern telecommunication systems. The capacity of optical fiber systems is moving upward and distances get longer due to the exploding demand of the internet. The Integration of optical fiber sensors into fiberreinforced plastics which work according to the principle of Fiber Bragg Grating (FBG) is already state of the art. Among the production techniques which allow embedding of the sensors into the components are laminating techniques and resin transfer molding. The integration of FBG sensors into the molding process on the other hand has hardly been analyzed. The objective of this master thesis is to work out basic knowledge for the integration of FBG sensors in plastic injection molding (PIM) components and to analyze embedding those sensors into metal injection molding (MIM) components. In this course of the study, suitable injection molds were modified to allow fixation of optical fibers and process parameters were adapted to allow reproducible integration of the fibers. The interface between the fiber and material was also evaluated in terms of interfacial shear strength to observe any bending between them. The resulting polymer components were mechanically tested under tensile load to determine the influence of the fiber on general mechanical characteristics. Besides, the performance of the sensors with respect to their response to thermal and mechanical load was tested. It was concluded that samples with integrated fiber has raised the tangential strength of the material compared to sample with no fiber by 20%. The change in the centre wavelength of embedded fiber was about 1.2 nm / 100 °C which was higher than that of the non-embedded fiber, reaching 1.05 nm/100 °C. Strain testing shows that stronger bending shifts the centre wavelength to higher values and reversal from stronger to weaker bending shifts the centre wavelength to lower wavelengths (fiber assumed to be an the sample side loaded in tension). The interface between fiber and material was found to be 0.187 MPa, which is too low to prove any bonding between them.