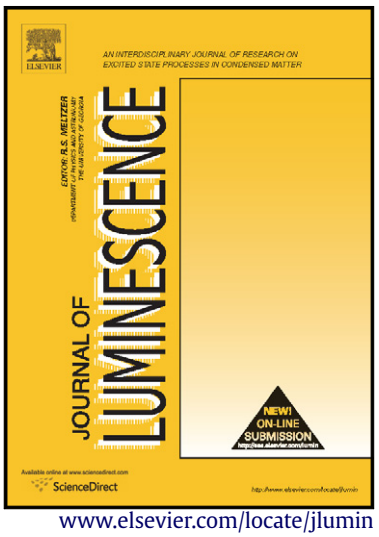

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Real Time Failure Detection in Unreinforced Cementitious Composites with Triboluminescent Sensor

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Abstract

The *in-situ* Triboluminescent Optical Fiber (ITOF) sensor has an integrated sensing and transmission component that converts the energy from damage events like impacts and crack propagation into optical signals that are indicative of the magnitude of damage in composite structures like concrete bridges. Utilizing the triboluminescence (TL) property of ZnS:Mn, the ITOF sensor has been successfully integrated into unreinforced cementitious composite beams to create multifunctional smart structures with *in-situ* failure detection capabilities. The fabricated beams were tested under flexural loading, and real time failure detection was made by monitoring the TL signals generated by the integrated ITOF sensor. Tested beam samples emitted distinctive TL signals at the instance of failure. In addition, we report herein a new and promising approach to damage characterization using TL emission profiles. Analysis of TL emission profiles indicates that the ITOF sensor responds to crack propagation through the beam even when not in contact with the crack. Scanning electron microscopy analysis indicated that fracto-triboluminescence was responsible for the TL signals observed at the instance of beam failure.

Keywords

Triboluminescence; sensors; smart structures; composites; damage monitoring; multifunctional