Development of Full-field Strain Sensor using Mechanoluminescence Materials

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In this work, Mechanoluminescence (ML) strain sensing film has been developed for measuring full-field strains. Unlike traditional strain gages that can measure strains point-by-point, the developed ML strain sensing film can measure full-field strains being an innovative sensing method. During the past two decades, Mechanoluminescence (ML) materials have been extensively investigated for a possibility that they could be used as stress sensors. They have showed its promising applications to full-field stress sensing, detections of fracture and impact damage, visualizations of crack propagation and stress distributions in structures. Effects of the loading rate on the light intensity changes have also been investigated by other researchers. However, research on possibility of using ML sensing films as a full-field strain sensor has yet been carried out. Moreover, practical issues in using ML materials as a full-field strain sensor have yet been fully addressed.

In this study, a thin-film-type $SrAl_2O_4$:Eu,Dy (SAOED) phosphors is used to develop a novel full-field strain sensor. SAOED film is coated on dog-bone aluminum specimens and tested within elastic strain range of the aluminum alloy. Images are captured by a CCD camera and the light intensity was measured through image processing. Several tests with different strain rates are conducted to find a relation between light intensity, strain and strain rate and a methodology to calibrate the light intensity to the strain values has been developed. Finally, sensing capabilities of the ML strain sensing film is verified through experimental tests.