Sound and Triboluminescent Correlation of Manganese Doped Zinc Sulfide Doped Resin Beams

Campbell, Christopher

The objective of this study was to demonstrate the validity of triboluminescence (TL) as a structural health-monitoring characteristic within composite materials. Fiber reinforced composite laminates tend to micro-crack unpredictably due to variation within a composite's structure such as fiber waviness or porosity; this has caused a need for an active monitoring technique that can quantify the mechanical stress within composites to demonstrate its current structural health. Triboluminescent materials have a physical property that allows them to emit photons upon mechanical stress within the material. In order to relate triboluminescence to the structural health of the composite, the light emitted must be quantifiably correlated to a propagating crack, which is not best associated with the mechanical stress but rather with the noise emitted from the propagating crack. Sound and light emitted from manufactured composites containing vinyl ester resin, which is commonly used as a matrix material within composites, glass fibers, and Manganese doped Zinc Sulfide, a material with a triboluminescent property were measured during a three-point bend test on the MTS insight machine and statistically analyzed using MATLAB to provide significant evidence of the relationship. The correlation between the TL emitted from Zns:Mn and the acoustic micro cracking emissions showed a sufficiently high positive peak at approximately .5 over a time lag of zero- displaying that the two elements quantified, light and sound, were substantially related. The physical applications involve common failures such as fiber breaks and matrix cracks within structures being addressed and false alarms of composite fractures being reduced.

Awards Won: