Potential for Developing Smart Materials Using Tribolumininescence

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The emission of fluorescence due to mechanical excitation, or triboluminescence (TL), is a phenomenon that has been known for centuries. One of the most common examples of TL is the flash created from chewing wintergreen Lifesavers®. For the last several years, the authors have measured the production of TL from projectile impacts over the energy range of 1 m/s to 6 km/s. A so-called 'smart' structure with embedded TL material could be capable of determining whether a particle had struck, and record the relative intensity of its impact. Through the use of specific fluor material, it is believed that sensors can be developed that will indicate the occurrence of an impact and its location. To apply TL to a damage sensor, it would need to be incorporated into some type of smart material or coating. This combination might need to have a phosphor suspended and evenly distributed in a resin that would then cover a grid of optical fiber. The optical fibers would be used to capture the emitted light and transmit it to a series of detectors. Through the careful monitoring, the entire exterior of any structure could be a passive sensor that can locate and possibly determine the impact velocity or energy of a debris strike.