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Using triboluminescence as the active element for impact sensors

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A phosphor is a substance that emits luminescence that is not caused by incandescence. The word phosphor comes from Greek meaning *"light bearer"*. Phosphors are able to emit light due to the absorption of energy from an external source. One such source, triboluminescence (TL), is defined as the emission of light produced by mechanical action. This word comes from the Greek *tribein,* meaning "to rub", and the Latin prefix *lumen,* meaning *"light"*. TL is observed in approximately 30% of known organic and 50% in inorganic crystals and was first discovered by Sir Francis Bacon more than 400 years ago. A classic example of TL is found in the crystals used for real old-fashioned wintergreen flavored Lifesavers®. The green/blue sparks seen when chewing the candy is TL light being emitted from crystals breaking in the sucrose. TL can also be produced by peeling tape in a vacuum or possibly as a result of plate tectonic movement during and just prior to earthquakes. The exact mechanism of TL is currently unknown. Since 2003, my students and I have been conducting a rigorous research program into measuring the triboluminescent properties for more than thirty inorganic and organic phosphors, such as zinc sulfide doped with manganese (ZnS:Mn) and europium tetrakis dibenzoylmethide triethylammonium (EuD4TEA), respectively. This presentation will show some results from this research and indicate how TL can be used as the active element for impact sensors for speeds ranging from less than a meter per second to a few kilometers per second.

Biography

William A. Hollerman is the Dr. and Mrs. Sammie W. Cosper/BORSF Endowed Associate Professor of Physics at the University of Louisiana at Lafayette. He has been on the faculty there since 1999 and has published many articles in triboluminescence, radiation physics, and applied physics/ engineering, in periodicals such as the *Journal of Luminescence, Materials Letters, Materials Today, Journal of Instrumentation, CrystEngComm, Measurement, IEEE Transactions on Nuclear Science, Nuclear Instruments and Methods in Physics Research, Journal of Materials Research, and the Journal of Nuclear Materials.* He has given presentations on a variety of scientific and technical topics to hundreds of participants.

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Resonant frequency analysis of clamped-free multi-walled boron nitride nanotube (MWBNNT) based mass sensor

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In the present work, the simulation of individual boron nitridenanotubestreated as thin shells with considerable thickness has been done in order to identify the dynamic response using finite element method (FEM). Lennard-Jones model is employed for estimating the van der Waals interaction between two adjacent layers of multi-walled -boron nitride nanotube (MW-BNNT). Resonant frequencies and corresponding shift in resonance frequencyof clamped-free MW-BNNT,caused by the changes in its size in terms of length as well as the attached mass along with its positionhave been investigated. The results show the mass sensitivity of MW-BNNTs based nanoresonators can reach up to 10-24 kg and observed that it is higher for smaller size of resonators. In order to explore the suitability of the MW-BNNT as a mass detector device, the simulation results are compared with analytical results and found in good agreement and hence the current modeling approach is suitable as a design tool for the development of MW-BNNT based nano electromechanical systems.It is also observed that as mass approaches towards fixed end, resonant frequency increases. Hence, it is concluded for better sensitivity it is obvious to attach mass at tip of the clamped-free MW-BNNTs for obtaining higher frequency shift.

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