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Spray-on ferroelectrics for fabrication of custom tailored composite transducers for NDE and SHM for mech-aero applications

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Applications for non-destructive evaluation (NDE) and structural health monitoring (SHM) in principle can be performed on systems at various temperatures. Whereas there are high temperature materials such as lithium niobate that can be used for NDE; they require a coupling medium. Traditional methods require either a pressure contact or a high temperature bonding medium, which can deteriorate over time. Sol-gel spray-on sensor technology is attractive for permanently attached sensors because it does not require an intermediate bonding agent between the actuator and the substrate to be examined. The temperature dependency of the sensor then becomes a function of the actuator, rather than of the bonding agent. Another advantage of the sol-gel technology is that the actuator can be custom tailored to the specific application of interest. Additionally, use of sensors that can be deposited on complex geometries capable of withstanding high temperatures could be useful for real-time monitoring of a variety of heavy machinery and aeronautical components, that otherwise must be taken out of service at regular intervals for inspection. Our current objective is to develop a class of spray-on ferroelectrics that do not require a bonding medium and enable custom tailoring of composite transducers adapted for different combinations of efficiency and temperature. This paper presents details of the deposition method without requiring a bonding medium. It also shows results on the effects of varying the weight percent of the composite lead zirconate titanate (PZT)/ bismuth titanate (BiTi) transducers on the Curie temperature and efficiency of the composite ferroelectrics.

Biography

Bernhard R Tittmann is the Schell Professorship of Engineering in the Department of Engineering Science and Mechanics at the Pennsylvania State University, University Park, Pennsylvania. He established and has been the Director of the Pennsylvania State University Engineering Nano-Characterization Center since its inception in 1994. He is best known for his contributions in Physical Acoustics to Materials Characterization, which first led to the study of Superconductivity, then Rock Mechanics, SAW devices, NDE, Sensors for Process Monitoring and Control of Composites, Sensors for Health Monitoring of Pressure Vessels and more recently Acoustic Microscopy of Biological cells and tissue. He has over 461 publications.

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