TSF12-2012-000104

Abstract for an Invited Paper
for the TSF12 Meeting of
the American Physical Society

Characterization and Optimization Multiscale and Multicomponent Nanosystems[1]

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Materials with new combinations of properties are increasingly needed to meet the requirements of energy, transportation, and medical applications. The use of multi-component systems, with potentially complementary properties, represent a unique path to improve materials properties for a variety of applications. Among the most interesting applications of these materials is in the development of contrast agents in biological imaging and dynamic sensing applications. Although a variety of techniques to characterize these materials exist, noninvasive characterization methods, such as optical-based techniques, are ideal for studying these materials in their native states and for monitoring dynamic changes. The proposition becomes even more attractive when at least one of the components carries an optical signature.The use of optoacoustic (OA) is an emerging technology based on studying optically absorbing nano and microstructures in the sample by recording transit pressure waves generated from laser-induced thermal expansion. More recently OA has been developed as a vibrant technology for medical applications and some growing applications is for material characterization in research and industrial applications. Specifically, OA can assist in the characterization and optimization of composite materials containing nanoparticles when paired with other characterization techniques. The present work illustrates an overview of select hybrid nanomaterials, including their unique optoacoustic signatures utilizing an all optical OA technique. The results of this work show that optical based techniques such as OA, provide a noninvasive, nondestructive means to study multi-material, multi-scale, multi-functional materials are important in the development of novel multi-component nanomaterial schemes and elucidating the structure-function relationship in these materials.

[1]This work is partly supported by the National Science Foundation Partnerships for Research and Education in Materials (PREM) Grant No. DMR-0934218 and the UTSA-SwRI Connect Program.