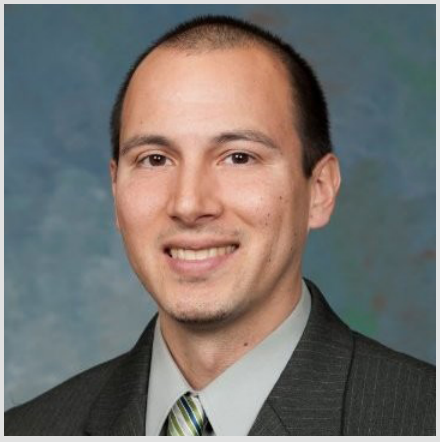
MAE Seminar Series

Energy Coupled to Matter Research for Field-Enhanced Processing

Thursday,
May 17
3:30 pm
Knox 14



Dr. Raymond Brennan
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ABSTRACT

Energy Coupled to Matter (ECM) research at the U.S. Army Research Laboratory is focused on the study of material interactions with external fields to produce outcomes that are unattainable through conventional means, expanding materials-by-design and processing science capabilities beyond the current state-of-the-art. Research has been conducted to utilize these innovative technologies and material solutions for exploring structure-property relationships of materials based on their interactions with applied fields. The application of magnetic, electric, microwave, and other types of external fields during heat treatment often has a profound influence, altering the free energy of the system and enabling densification of materials at lower temperatures and shorter times compared to standard sintering processes. The ability to rapidly densify materials under less extreme processing conditions can allow for preservation of the nanoscale, providing the opportunity to improve mechanical properties that are vital to Army protection applications, including strength, hardness, and fracture toughness. In addition, techniques for manipulating materials to make them more responsive to specific fields have been investigated to amplify these effects. Fabricating materials containing rare earth/transition metal dopants or ferromagnetic additives has helped to increase the response to applied magnetic fields, influencing phase formation and enhancing susceptibility, conductivity, and other key magnetic properties. Similar parallels have been explored for the integration of electrically conductive phases that generate pathways to enhance electric field processing, and susceptor materials that react to microwaves and induce localized heating. Strategies in experimental design, computational modeling, and in-situ characterization have been employed to develop unique ECM processes for field-enhanced processing of unique components. These revelations have led to increased interest in the influence of fields over material phases and properties.

BIO SKETCH

Dr. Raymond Brennan is a materials engineer at ARL under WMRD. He received his PhD from the Materials Science and Engineering Department at Rutgers University in June 2007 for work on "Ultrasonic Nondestructive Evaluation of Armor Ceramics". Dr. Brennan was hired as a postdoctoral researcher at ARL in August 2007 and as a civilian employee in August 2009. He has authored or co-authored over 60 publications, and presented invited talks at numerous national and international conferences. Dr. Brennan initially worked at ARL as the WMRD lead in nondestructive inspection, testing, and evaluation, conducting research & development for supporting the Army's needs in quality control, material & structural design, post-mortem analysis & failure assessment, real-time health monitoring, and component repair & replace decision-making. He has since taken on a role as the ARL lead in Energy Coupled to Matter research, applying external physics-based fields (electric, magnetic, acoustic, microwave, etc.) for developing novel materials with tailored microstructures & properties, enabling innovative processing capabilities, and exploring adaptive/responsive Warfighter technologies.

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