**CAREER: Hard and Tough Boron Rich Ceramic Laminates Designed to Contain Thermal Residual Stresses**

This CAREER proposal describes an integrated research and educational project to develop hard and tough boron carbide and aluminium magnesium boride based laminates with controlled compressive and tensile stresses in separate layers. Laminates with strong interfaces provide high fracture toughness, increased wear resistance and damage tolerance. As a result, these composites exhibit improved reliability and durability. The enhancement of the mechanical performance of laminates will be obtained through design of controlled residual stresses in separate layers.

**Intellectual Merit:** This research will produce fundamental knowledge and understanding of the interrelationships between processing, residual stresses, and mechanical behavior of boron rich multilayered ceramic composites. The CAREER project will lead to the development of wear resistant, damage-tolerant ceramics with enhanced mechanical properties far exceeding those of currently available non-oxide ceramics.

The proposed modeling-experimental program will demonstrate unequivocally that the concept of controlled residual stresses can be employed to produce high performance ceramic laminates. Samples of boron carbide-silicon carbide multilayered ceramics with controlled residual stresses will be designed and further manufactured by rolling and hot pressing/hot isostatic pressing. The research will result in a clear identification of the microstructural parameters that control residual stresses in laminates. In addition, mechanical properties such as strength, hardness, wear resistance, and fracture toughness will be measured to confirm the increase in the mechanical performance of the laminates.

This CAREER research will produce a novel technology for laminate manufacturing and improve the fundamental understanding of laminate toughening mechanisms.

**Broader Impacts:** The proposed project will provide an ideal basis for Mechanical, Materials and Aerospace Engineering students to actively participate in project-based learning. Integrated research and educational activities include outreach to a diverse group of middle and high school students and research opportunities and course enhancements for undergraduate students. Graduate students will be involved in research, presentations at technical meetings, and will mentor undergraduate and high school student researchers. In addition, students will benefit from global research opportunities through the project's collaboration with a new network of international researchers. The PI will take part in UCF Bridges summer program that will allow her to work closely with bright and talented students to attract them to engineering fields. Both undergraduate and graduate students' research will likely result in high-profile publications and presentations at prestigious conferences. Special efforts will be made to attract underrepresented students to careers in materials science and engineering through the high school outreach and undergraduate research components. Graduate and undergraduate students involved in this project will have a unique opportunity to be a part of a cutting-edge, international materials development research team.

Ultimately, society will benefit from this program through development of novel reliable and robust systems and devices which are able to contribute to the better life of our people.