Ceramics are ubiquitous in manâ€“made and natural structures. Their mechanical properties highly depend on their composition, microstructure and level of defects in the bulk of the material, the latter affecting the integrity of the components; such is the case of boron-rich ceramics where large agglomerates create high stressed regions, or coral skeleton where porosity determines their strength against hydrodynamic forces present in the ocean tides. Therefore, studying the properties of ceramic materials using invasive and non-invasive methods helps in the understanding of the link between the properties and the performance of the structures. The aim of this research was to test the novel ceramic component ZrB2â€“30wt%SiB6 and Acropora cervicornis coral skeleton using non-conventional techniques that allow for the study of their mechanical properties and their behavior when exposed to external loads present in their environments of application. The first part of this study focuses on understanding the effects of adding SiB6 to enhance the mechanical properties of ZrB2 ceramics for their ultra-high temperature use. The second part will emphasize in the behavior of Acropora cervicornis coral skeleton when exposed to compressive forces and the effects porosity has on this structure when subjected to such loads. It was found that the SiB6 phase was not stable after sintering of the composite and large agglomerates were present in the surface of the material acting as stress concentrators, thus compromising the biaxial strength of the component that resulted to be 224.9 MPa. It was also found that coral skeletons are highly susceptible to porosity which creates variability on the elastic modulus ranging from 60â€“1 GPa for simulated porosity of 0â€“90% respectively and a strength of 3.56 ± 0.31 GPa obtained through Vickers indentation. Finite element models were developed and validated against experimental results for the ZrB2â€“30wt%SiB6 and Acropora cervicornis coral skeleton.

Major: Mechanical Engineering

Educational Career:
Bachelor's of Mechanical Engineering, BS, 2012, Western Michigan University
Master's of Engineering Management, MS, 2014, Western Michigan University

Committee in Charge:
Kawai Kwok, Chair, Mechanical & Aerospace Engineering
Jihua Gou, Mechanical & Aerospace Engineering
Nina Orlovskaya, Mechanical & Aerospace Engineering
Fernando Uribe-Romo, Chemistry

Approved for distribution by Kawai Kwok, Committee Chair, on March 27, 2019.

The public is welcome to attend.