

*The Department of Mechanical Engineering presents:*

# ***The Ph.D. Dissertation Defense of David Halaney***

**Tuesday, February 16, 2021,  
8:30-10:45am Pacific time**

## **The Feasibility of a Transparent Cranial Implant for Chronic Structural and Functional Brain Imaging**

Doctor of Philosophy, Graduate Program in Mechanical Engineering  
University of California, Riverside, February 2021  
Dr. Guillermo Aguilar, Chairperson

A variety of medical conditions (e.g. traumatic brain injury, cerebral edema, stroke, brain tumors) necessitate surgical craniectomy to access the brain, followed by the placement of a cranial implant to replace the excised cranial bone. Cranial implants provide mechanical protection to the brain, and are made from a variety of materials ranging from polymers to metals and ceramics. Despite this variety of implant options, all current cranial implants for patient use lack optical transparency which could allow for brain imaging or therapy without additional open-skull procedures. The “Window to the Brain” is a novel transparent cranial implant made from a tough, biocompatible ceramic called nanocrystalline-Yttria Stabilized Zirconia. Preliminary studies have shown that this material allows for acute brain imaging in vivo, but its suitability for chronic use has not been established. In this dissertation, I investigated (1) the stability of the optical access provided by the window for chronic brain imaging in vivo; (2) functional and structural imaging techniques across the window; (3) laser bacterial antifouling strategies for use with the window; (4) characterization of the window’s optical properties which impact imaging. This work provides answers to some of the key remaining questions regarding the feasibility of a transparent cranial implant for chronic structural and functional brain imaging based on nc-YSZ.