

Faculty of Engineering

ASPIRE Summer Research Program 2026-2027

Project Title: Thermal-Barrier Design for Titanium Cranial Implants

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Objective

Design and validate a manufacturable thermal-barrier strategy that reduces transient heat transfer through Ti-6Al-4V cranial implant structures while accounting for structural and integration constraints. The project will deliver a validated benchtop/finite element comparison, ranked design options and a follow-on design specification for future implant development.

Project Details

Patient-specific titanium cranial implants are strong, biocompatible and well suited to metal additive manufacturing; however, titanium can transmit external temperature changes more rapidly than native cranial tissues, which may produce a different transient thermal response under defined boundary conditions. This project will quantify the problem under controlled, non-clinical conditions and compare practical insulation concepts. The student will define representative temperature transients, build a simplified transient thermal model and benchmark a Ti-6Al-4V coupon or implant-like geometry. Two to three concepts - such as an architected low-density zone, a candidate low-conductivity coating or liner, and a hybrid titanium-polymer layer - will be screened for thermal performance, thickness, weight, basic structural performance, manufacturability and integration constraints. Selected concepts will be tested on a safe benchtop rig using synthetic tissue analogues and temperature sensors, and the results will calibrate the model. Outputs will include a repeatable test method, evidence-based design recommendations and a preferred concept for follow-on mechanical and biological validation. No patient data, human participants or clinical claims are involved.

Project Timeline

[illegible]

Concepts / DfAM screen										
Coupon / prototype prep										
Benchtop thermal tests										
Model validation / ranking										
Report / design guide										

Prerequisites

Mechanical, materials, biomedical, mechatronics or related engineering; heat-transfer/materials fundamentals. CAD/FEA and MATLAB/Python are desirable, not essential. Training provided.

Student Placement Agreement

A student placement agreement must be signed by the project supervisor and the student prior to commencement of the ASPIRE program.

[LV0554-72741 ASPIRE Program Co-Curricular-Student-Placement-Agreement-Short-term.docx](#)

Additional Information

Applicants may be interviewed. This is a non-clinical engineering project. Laboratory work requires local OHS inductions and approved materials.