Faculty Name: Mark Towler

Project Title: Novel Glasses for Orthopedic Applications

Description of Project (Provide ½ page project description)

In order to design surgical coats that retard bacterial infection and promote formation of dense bone in patients with low bone mass or compromised healing, this project has three interrelated objectives:

1) Apply regression models to formulate borate glasses substituted with ions of therapeutic ability that have thermal expansion comparable to Ti6Al4V implants. 2) Identify processing parameters based on viscous flow to enamel the glasses onto implants. 3) Evaluate their surgical applicability through mechanical, biological and clinical techniques.

The team will test three hypotheses: 1) A statistical model can identify degradable borate glasses. 2) Glasses can be glazed onto Ti6Al4V substrates. 3) Coats degrade in vivo, inhibiting bacterial proliferation and stimulating bone formation through ion release, with or without the incorporation of bone morphogenetic proteins, which promote bone formation, thus minimizing the need for revision.

The research will synergize results from engineering and medicine to design glasses with comparable thermal expansion to metal. Surgical glass coats are not clinically available because silica glasses crack during glazing. The team has developed silica glasses containing active ionic species that minimize bacterial proliferation and stimulate dense bone formation. The incorporation of the active ions from the previous research, into a borate, rather than silicate, glass, could eliminate cracking caused by mismatched thermal expansion, offering coating applications. Borate-based coatings may reduce common causes of revision: aseptic loosening, sepsis and cases where a patient’s healing process is compromised. The commercialization of this technology will decrease the need for revision surgeries, which represented 10.1% of the reported 17,303 hip replacement surgeries performed in 2010-11. At double the primary surgery cost, the demand for revision arthroplasty is placing considerable strain on the Canadian healthcare system.

Responsibility of Student (Specify the duties and responsibilities of the student)

The student will be trained to synthesise and manufacture a series of five glass components that will be used to coat a surgical metal. The student will characterize these materials physically, mechanically and biologically. The student will work with three graduate students and one post-doctoral fellow on this CIHR/NSERC funded project.

Specify Requirements (Please state any specific requirement of this position)

BME undergraduate student. Minimum second year.