Solid-state Nuclear Magnetic Resonance Spectroscopy of Next-Generation Materials

PROJECT DESCRIPTION

With their incredible potential to be chemically tuned for specific functions, materials encompass an amazing range of chemical systems from bioactive catalysts and structural matrices to photovoltaics. Despite this success, the “trial & error approach” employed for hard and soft materials has stifled advancements. Demand for further improvements in biomaterials is prompted by an aging global population and by the fact that the majority of people will require treatment for dental caries. The formation of Apatite, A5(XO4)3Z, is one important process for biocompatibility. Apatite is a class of phosphate minerals that can accept varied ion substitutions at the A, X and Z positions. Scientific researchers have used the A and X positions to produce various functions within apatite including ionic conduction and long-term nuclear waste storage. Earth scientists have utilized Z substitutions for petrology indicators within igneous and metamorphic rocks, including lunar research. Z-site substitutions (Z = OH, F or Cl) of hydroxyapatite (HA, Ca5(PO4)3OHX) is essential for calcification within living hard tissues including human dentin and bone, and hypermineralization within crustaceans. Our current research program is directed at inorganic biomaterials of ordered (apatite based) and disordered (bioglass-ceramics) materials to characterize and improve oxide-containing biomaterials used for replacement or regeneration within the dental and medical applications. Using high temperature synthesis, sol-gel or nature (i.e., biominerals) we design and control functionality by studying the underlying local- and medium-range solid structure using solid-state nuclear magnetic resonance spectroscopy (SSNMR). Characterizing the structure(s) and measuring the physical properties of these materials offers insight into design and synthesis needed to improve the function of the glass, cements, etc. as better adapt these materials for clinical application. SSNMR is the single most important structural tool we have at our disposal to identify and quantify atomic-level structure in these ordered and disordered solids. Research candidates should have an urge to use chemistry and materials to improve the well-being for all humanity through environmental and social health applications. Interest and skills with high temperature oxide chemistry, biomaterials, glass-ceramics, physical/materials chemistry and/or a background in SSNMR would be valuable assets for this program. Renewable energy areas including catalysis and photovoltaics is also an active stream within the group.

FACULTY-DEPARTMENT

Science - Chemistry

OPEN TO STUDENTS FROM THE FOLLOWING INSTITUTIONS

Chinese universities participating in the *Double First-Class Initiative*.

DESIRED FIELD OF STUDENT STUDY

Chemistry, Physics, Chemical Engineering

INTERNSHIP LOCATION

Edmonton Campus

NUMBER OF INTERNSHIP POSITIONS

2

INTERNSHIP DATES

Start: July 2, 2019

End: October 2, 2019

ARE THE DATES FLEXIBLE?

Yes, I am flexible regarding the internship dates. Selected students can contact me to request a date change.