**CSACS summer project**

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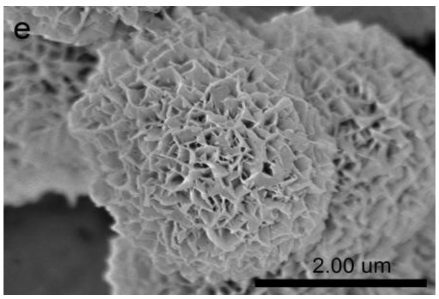
# Nucleation and growth of hydroxyapatite nanoparticles



Hydroxyapatite microsphere synthesized by PhD student Maryam Tavafoghi Jahromi in Cerruti's lab

No man-made material can match the combination of strength and elasticity that nature achieves in our bones. These extraordinary mechanical properties are mirrored by an extraordinary structure: all the way from the macro to the nanoscale, bones show a complex hierarchical architecture. Fibers made of the protein collagen are intertwined at several levels, forming highly oriented structures. Within collagen fibers, nanocrystals of the calcium phosphate mineral known as hydroxyapatite are deposited. Hydroxyapatite crystals form with very precise size, shape and orientation along the collagen fibrils. Although our body fluids are supersaturated with hydroxyapatite, this mineral normally does not form in other collagen-rich tissues such as cartilage or arteries. The reason for this lies in the presence of non-collagenous proteins that direct the process of apatite formation. These proteins are rich in negatively charged amino acids, which are responsible for their strong affinity with calcium ions. Although the importance of these amino acids is clear, the details of their role in directing hydroxyapatite nucleation are unknown. Recent work from Cerruti's lab shows that positively charged amino acids can strongly inhibit the formation of apatite too. In this project we want to study the fundamentals of the process of apatite nucleation and growth, and how negatively and positively charged amino acids can influence it. We will prepare hydroxyapatite nanoparticles in the presence of different amino acids and oligopeptides. We will study how the hydroxyapatite clusters nucleate and evolve using the instruments present in Wilkinson's lab, one of the best equipped in Canada for nanoparticle analysis, and we will analyze the resulting nanoparticles with the spectroscopic techniques present in Cerruti's lab, which includes for example a unique microscope combining FT and dispersive Raman spectroscopy.