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FTIR Studies of Abalone
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Introduction: Understanding the mechanical behavior of mineralized tissues (bones, teeth, shells, etc.) is crucial both to the design of better implants, prostheses, and dental restoration materials and to protecting against traumatic injuries. Very little is known about the distribution of stresses between the organic and mineral phases in these tissues under various kinds of loading. The nacre layer of abalone shell consists of an organic network containing aragonite platelets. An attempt was made to determine the average distribution of applied strains within the organic phase of the nacre layer of abalone shell by applying controlled loads and FTIR analysis.

Methods and Materials: FTIR can be used to identify chemical species and phases, determine molecular orientation and structure of gases, liquids and both crystalline and non-crystalline solids. Here, laser light is absorbed by a material, which excites vibrations in atoms and molecules causing bonds to stretch, rotate and translate. An FTIR spectrometer detects light intensity changes emitted by the sample as a function of frequency or wavenumber.

A strain gage was mounted to an nacre bar/sample, which was wet cut from a large dry abalone shell. The sample was placed in four point flexure, and the applied load was calibrated to the strain gage reading from the compressive face. Later the sample was mounted in four point flexure on the spectrometer, and FTIR band shifts were sought as a function of load/strain from the organic phase.

Results: The C-H stretching vibrations at 2913 cm^{-1} from the organic phase of the nacre were monitored as a function of load. Unfortunately, no apparent frequency band shift greater than 4 wavenumbers was observed as a function of applied bending load to the sample. Although difficult, it was hoped to calculate values for changes in bond distances based on vibrational frequency shift as qualitative evidence of a change in bond length of the organic phase in the abalone as a function of applied load.

Conclusions: FTIR spectra of the organic phase of abalone were inconclusive with regard to load transfer.

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