Physics Colloquium

University of Missouri-Kansas City
Department of Physics

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Scaled FE Modeling of the Mechanical Behavior of Biominerals using a VIB (Virtual Internal Bond) Model

Mineralized Type-I collagen fibrils are made up of the mineral hydroxyapatite [Hap] and Type-I collagen and are known to have good mechanical properties. Hydroxyapatite by itself is stiffer, and collagen is relatively weaker. The development of a multi-scale virtual internal bond model (VIB) used to model the material behavior and failure of such biocomposites was described in an earlier paper by the authors. A new explicit finite element based framework was presented, by which the mechanical behavior of mineralized collagen fibrils and their constituents can be studied. A two parameter fracture-constitutive VIB model, with an extrinsic length scale, was used in the study.

This work presents the study of the effect of the variation of material parameters and the quasi-static nature of the explicit finite element simulations. The model used in the study is a nano sized dahlite mineral crystal commonly found in collagen fibril. Two important implementation characteristics are presented here; namely the effect of a material parameter used in the VIB model and the effect of thickness of the material at the nanoscale on the failure behavior. The effect of the thickness is studied in order to demonstrate the extrinsic length scale capability of the VIB model at nano length scale levels.

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Coffee at 3:10, Colloquium at 3:30 in Room 310