

Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Physical controls on matrix mineralization¹ JINHUI TAO, MIKE NIELSEN, JIM DE YOREO, Lawrence Berkeley National Laboratory — During biomineral formation, protein matrices impose order on nucleating mineral phases. While many studies have examined the structural relationships between mineral and matrix, few have explored the energetics. To address this gap we use *in situ* TEM and AFM to investigate calcium phosphate nucleation and growth in collagen and amelogenin matrices. *In situ* TEM results indicate that, in the absence of calcium, amelogenin nanospheres are loose aggregates of oligomers, while in the presence of calcium phosphate solution, can form chain-like structures and become mineralized with an amorphous phase before the appearance of crystalline phases. Results on collagen reveal the evolution of nucleation pathways from direct to indirect with increasing supersaturation and analysis of nucleation rates using classical theory demonstrates a reduction in interfacial energy due to matrix-mineral interactions. However, the calculated thermodynamic barriers are in contradiction to the observed pathways and well in excess of sensible values. We present a model based on cluster aggregation within the classical context that reconciles experiment and theory.

¹Authors would like to acknowledge grant no. DK61673 from the National Institutes of Health. Theoretical analysis was supported by Office of Science, Office of Basic Energy Sciences of the U.S. Department of Energy under Contract no. DE-AC02-05CH1123.

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Date submitted: 29 Nov 2012

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