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**Controlling growth kinetics and morphology of crystal surfaces through biomolecular interactions** JIM DE YOREO, ROGER QIU, Lawrence Livermore National Laboratory, SELIM ELHADJ, PATRICIA DOVE, Virginia Tech, GERMAINE FU, DANIEL MORSE, University of California at Santa Barbara, ALAN SALTER, ANDRZEJ WIERZBICKI, University of South Alabama — The complex shapes and hierarchical designs of biomineralized nanostructures arise from biomolecular controls over crystallization. One prevailing view is that mineral-associated macromolecules are responsible for nucleating and stabilizing non-equilibrium polymorphs and morphologies through interactions at crystal surfaces. Here we report results of *in situ* AFM and molecular modeling investigations of calcite growth in the presence of acidic amino acids, polypeptides, and proteins associated with biomineral formation. We show how the stereochemical relationship between modifier and crystal lattice lead to step-specific interactions and how those interactions account for the changes in kinetics and morphology. We analyze the results in terms of classic physical models of crystal growth and epitaxy and show that there are important deviations from those classic models that stem, in part, from the low kink density of steps on calcite. This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

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