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Biomineralization of a Self-Assembled Extracellular Matrix for Bone Engineering YIZHI MENG, YI-XIAN QIN, NADINE PERNODET[1], XIAOLAN BA, MIRIAM RAFAILOVICH, Stony Brook University, ELAINE DIMASI, Brookhaven National Laboratory — The mineralization of extracellular matrix (ECM) proteins is an important process in need of new experimental approaches. We present a study of two subclones of MC3T3-E1 osteoblast-like cells, one which mineralizes and one which does not. Using atomic force microscopy we measure the ECM protein fiber morphology and the elastic modulus, which changes as biomineralization proceeds. The non-mineralizing subclone undergoes less remodeling of the ECM over the same development period, compared to the mineralizing subclone. By using synchrotron grazing-incidence x-ray diffraction along with optical and electron microscopy, the development of hydroxyapatite crystals is followed. Cells are shown to mineralize only when an adequately structured ECM is present. Confocal light microscopy indicates that actin restructuring is correlated with mineralization. Correct and complete development of the ECM network, which can be interrupted either by using the non-mineralizing cell line or by culturing cells on an inhospitable substrate, is necessary for osteoblasts to mineralize. We discuss implications for bone biomineralization and for the development of implant materials.

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