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A mimic study on effects of fluoride on tooth enamel structures
GUOBIN MA, MU WANG, National Laboratory of Solid State Microstructures, and Department of Physics, Nanjing University, Nanjing 210093, China, XIANG YANG LIU, Department of Physics, Faculty of Science, National University of Singapore, 2 Science Drive 3, Singapore 117542 — Tooth enamel is the hardest tissue in human body, and this superior mechanical property is contributed by its unique microstructures, i.e., oriented growth of rod-like apatite crystals into basic structural units called the prisms Fluoride (F^-) has been recognized to have significant effects on the physical and chemical properties of tooth enamel. However, the role of F^- on microstructures of apatite crystals is not well understood yet. Here we report a detailed investigation on the topic. Mimic *in vitro* growth of tooth enamel structures is performed at the biophysical conditions in simulated body fluids, using belt-like hydroxyapatite crystals as substrates It shows that F^- on the order of 0.1 mM will dramatically change the morphology of the grown crystals from irregular slabs to nano-needles, and the needles are aligned along the substrate with an average misorientation of $\sim 12^\circ$. Branched growth of bundles of nano-needles occurs with further increase of F^-, and finally, growth of highly porous structures as well as microspheres takes place when the F^- concentration exceeds 5 mM. In comparison with real tooth enamel structures, the relationship between enamel microstructures and tooth caries as well as fluorosis is discussed.

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