

The Organization of the Organic Structural Framework in the Enamel Biomineralization Processes

Giuseppe Falini^a, S. Fermani^a, C. Du^b, J. Moradian-Oldak^b,^a*Department of Chemistry "G. Ciamician", University of Bologna.* ^b*University of South California, Los Angeles, CA, USA.* E-mail: giuseppe.falini@unibo.it

The growth of crystals within a preformed organic structural framework (the organic matrix) is a basic mode of skeletal formation adopted by many different organisms. Protein self-assembly into ordered structures is a critical step towards the control of mineral deposition in biomineralizing systems such as bone, teeth and mollusc shells.^[1]

Mammalian tooth enamel is the hardest tissue in the vertebrate body and is a secretory product of cells of epithelial origin called ameloblasts. Enamel mineralization is a dynamic process that includes protein secretion, matrix assembly and initiation and growth of the crystals within an amelogenin-rich matrix. The assembly of the mineralized enamel matrix continues through the transition stage during which ameloblast activity is drastically reduced and the bulk of the protein matrix is eventually processed during the maturation stage, concomitant with the rapid growth and maturation of the mineral. Supra-molecular self-assembly of the dental enamel protein amelogenin into nanospheres has been recognized to be a key factor in controlling the oriented and elongated growth of carbonated apatite crystals during dental enamel biomineralization. We report the formation of birefringent micro-ribbon structures that were generated through the supramolecular assembly of amelogenin nanospheres. These micro-ribbons have diffraction patterns that clearly indicate a periodic structure of crystalline units along the long axis. Linear arrays of nanospheres were observed as intermediate states prior to the micro-ribbon formation. The induction and c-axial orientated organization of apatite crystals parallel to the long axes of the micro ribbons were observed.^[2]

[1] Falini G., Fermani S., Roveri N., *Current Topics in Crystal Growth Research*, 2005, *in press*. [2] Du C., Falini G., Fermani S., Abbott C., Moradian-Oldak J., *Science*, 2005, *in press*.

Keywords: biomineralization, enamel, fiber diffraction