

PARADIM Accelerates Discovery of Nanoscale Chemical Gradients in Human Enamel Crystallites

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Dental enamel—the hardest substance in the human body—is the outer protective layer of teeth. It has evolved to bear large chewing forces, resist mechanical fatigue, and withstand wear over decades. Tooth decay (caries) and loss of dental enamel greatly affect health and quality of life, with associated costs to society.

At the nanoscale, enamel consists of tightly bunched elongated crystals that are about 1000 times smaller than a human hair. The tiny building blocks of enamel are mostly made of the calcium- and phosphate-based mineral hydroxylapatite.

Now, atomic scale imaging at PARADIM's Electron Microscopy facility coupled with atom probe tomography at Northwestern University reveals that the uniform arrangement of atoms in the crystallites incorporates further elements (magnesium, sodium, fluorine). Such impurities close to the core of each crystal give rise to strain, which might strengthen the enamel but renders the core more soluble. Exposure to acid led to more erosion in the core compared to the crystallites shell. The new insights will enable a better understanding of enamel degradation, how caries develops, and how to prevent or reverse it.

