

Supporting Information

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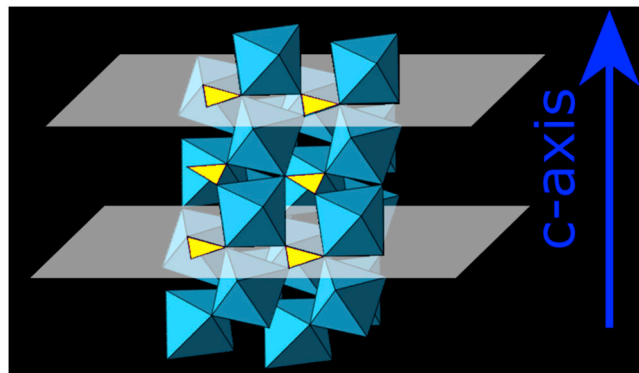
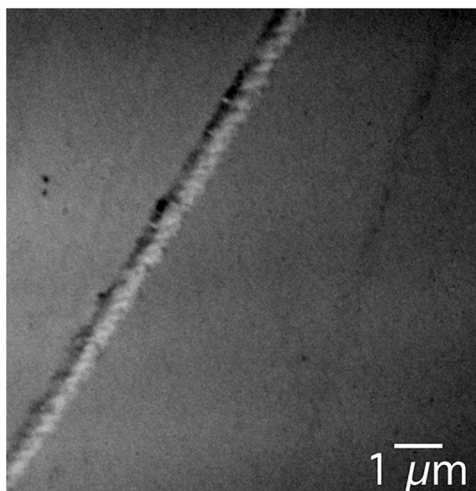
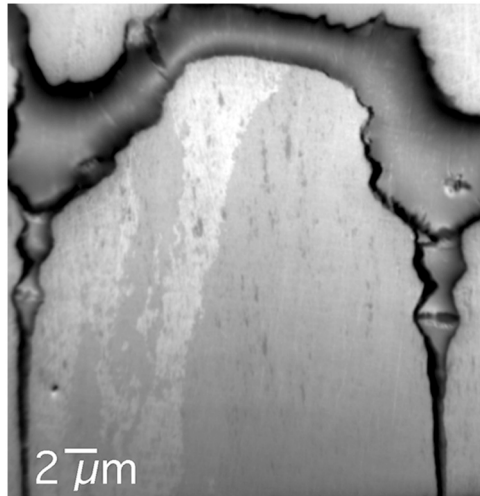


Fig. S1. The structure of calcite, the trigonal polymorph of CaCO_3 . In this polyhedral representation of the structure, each Ca^{2+} ion is a blue octahedron and each carbonate CO_3^{2-} ion is a yellow triangle, with carbon at the center and one oxygen at each vertex. The yellow carbonate triangles are planar, and they lie in parallel planes. Two of these planes are shaded in gray, each containing two yellow carbonate triangles. Across the entire crystal, all carbonate planes are parallel, and the c axis is perpendicular to them. Ca is coordinated by six oxygens from six different carbonates. The a and b axes lie into the carbonate planes, at 90° from each other and from the c axis.



Movie S1. Animated version Fig. 2A (upsidedown). The movie shows 19 images acquired with X-ray absorption near-edge structure–photoelectron emission spectroscopy (XANES-PEEM) from a crystal of geologic calcite, containing a line of defects, also made of calcite. The c axis of the main crystal is oriented vertically and in the plane of the sample surface. Each image was acquired at a different angle of the linear polarization vector with respect to the vertical direction, varying from horizontal [elliptically polarizing undulator (EPU)^o = 90°] to vertical (EPU^o = 0°) every 5° . Each image in the stack is composed of 106 pixels, and each pixel is 10 nm in size. Notice the change in gray level contrast as the movie animates. This is due to different orientations of the calcite nanocrystals in the defect line, compared to the main crystal.

[Movie S1 \(M4V\)](#)



Movie S2. Animated version Fig. 4A (upside down). The movie shows 19 images acquired with XANES-PEEM from a portion of one prism in the prismatic layer of the mollusk shell *Pinctada fucata*. Each image was acquired at a different angle of the linear polarization vector with respect to the vertical direction, varying from horizontal [elliptically polarizing undulator (EPU)^o = 90°] to vertical (EPU^o = 0° every 5°. Each image in the stack is composed of 106 pixels, and each pixel is 30 nm in size. Notice the change in gray level contrast as the movie animates. This is due to different orientations of the calcite nanocrystals in the prism.

[Movie S2 \(M4V\)](#)