QUANTITATIVE PHASE MICROSCOPY FOR ANISOTROPIC MATERIALS: STRUCTURAL IMAGING OF BIOMINERALS

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Quantitative phase imaging has revolutionized optical microscopy thanks to its capability to map phase-dependent physical quantities at the microscopic scale. However, it fails at addressing polarization-sensitive materials, which disqualifies quantitative phase imaging in many scientific areas, including life-science (tissues), materials science (biominerals) and optical engineering (metasurfaces).

In this context, the recent development of imaging techniques based on the Jones formalism [1], such as vectorial ptychography [2,3], opens new exciting perspectives provided that measured Jones maps are fully exploited. We propose a method that allows for the first time the exhaustive extraction from all optical information embedded in *experimental* Jones matrix maps. We introduce a generalized definition of the isotropic phase in the context of arbitrary Jones matrices. We show how to infer, from the combined knowledge of both isotropic and anisotropic optical properties, the underlying structure of the sample.

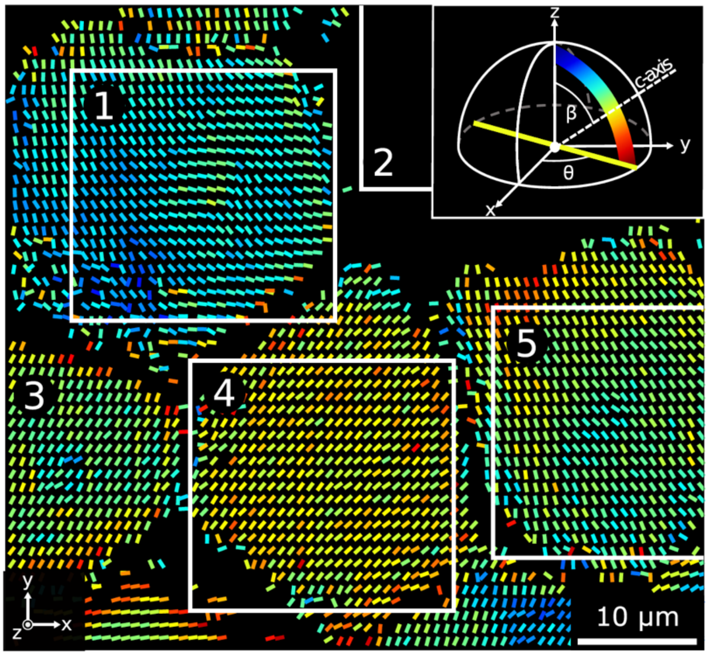

Figure 1. A biomineral specimen (oyster shell) investigated by vectorial ptychography. Reconstruction of the 3D orientation of the crystal axis.

The power of the method is confirmed by investigations carried out on a biomineral polycrystalline oyster shell specimen, where we succeed in mapping the variations of the three-dimensional orientation of the crystal axis (Fig. 1) and highlight structural defects in depth with an unprecedented level of precision. [4]

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