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Crystallographic Microstructure of Nacre

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We measured the crystallographic aspects of the microstructure of mollusk nacre for the species *Mytilus edulis* with high-resolution electron backscatter diffraction (EBSD). For the common Pmcn setting of aragonite (a = 4.97 Å, b = 7.97 Å, c = 5.75 Å, i.e. [001] perpendicular to the $[CO_3]^{2-}$ groups) the average c-axis orientation is perpendicular to the aragonite platelets with a near-Gaussian distribution in the order of ca. 25° FWHM in a scanned area of 20 x 40 μ m². In the a-b- plane many different discrete orientations are present, which may merge to a continuous cylindrical distribution with increasing scan area. On the grain scale we find that within the aragonite platelets of typically 900 x 4600 nm size the crystallographic orientation has a spread of 2.5° FWHM (compared to the experimental accuracy of +/- 0.3°). We attribute this spread to a mesocrystal architecture within the platelets. If "crystal grains" in the nacre are defined to be regions enclosed by grain boundary misorientations larger than 3.5°, the "crystals" composing the *Mytilus edulis* nacre occupy the space of several neighbouring aragonite platelets. We observe composite crystal "towers" or stacks of 20 platelets of similar orientation along [001] and 1-2 platelets along directions in the a-b-plane. Thus the platelets boundaries are defined by organic matrix and they do not necessarily imply a crystal grain boundary in the sense of a change of crystallographic orientation of the adjacent crystals. Between neighbouring towers the most frequent large-angle misorientation is the common 110 aragonite twin orientation system (which can leads to pseudohexagonal triplets).