American Mineralogist, Volume 90, pages 1693–1704, 2005

Structure of framboidal pyrite: An electron backscatter diffraction study

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ABSTRACT

The detailed crystallography of natural pyrite framboids has been determined for the first time using electron backscatter diffraction techniques. The crystallographic ordering of microcrystals correlates positively with morphological ordering; the crystallographic orientations are random in morphologically disordered framboids and are almost ordered in morphologically ordered framboids. Morphologically ordered framboids involve two types of systematic misorientations across the microcrystal boundaries: low-angle (ca. <20°) and high-angle (ca. 70–90°) misorientations. The low-angle misorientation probably reflects slight physical misalignment of microcrystals in the packing structure, whereas the high-angle misorientation is considered to result from the dichotomy of the pyrite microcrystals having fourfold morphological symmetry but only twofold crystallographic symmetry about <100>. Thus, the crystallographic orientation of microcrystals is not uniform, even in highly ordered framboids. This suggests that the self-organization of microcrystals in pyrite framboids is not crystallographically controlled, for example by sequential replication of existing microcrystals, since this would not result in high lattice misorientation angles between adjacent microcrystals. Presumably, the self-organization process is a consequence of the aggregation of multiple equidimensional and equimorphic microcrystals that have nucleated in a fixed volume. We suggest that the regular arrangement of microcrystals occurs by the physical rotation (reorientation) of individual microcrystals, driven by the reduction in surface free energy between neighbors.