BIOINSPIRED NANOCOMPOSITES: ORDERED 2D MATERIALS WITHIN A 3D LATTICE

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Key Words: bioinspired, nanocomposite, graphene oxide.

Advanced composites are used in a variety of industrial applications and therefore attract much scientific interest. We recently developed a novel carbon-based nanocomposite via incorporation of graphene oxide (GO) into the crystal lattice of single crystals of calcite [1]. Incorporation of a 2D organic material into single-crystal lattices has never before been reported. To characterize the resulting nanocomposites, high-resolution synchrotron powder X-ray diffraction, electron microscopy, transmission electron microscopy, fluorescence microscopy and nanoindentation tests are employed. A detailed analysis reveals a layered distribution of GO sheets incorporated within the calcite host (Fig. 1). Moreover, the optical and mechanical properties of the calcite host are altered when a carbon-based nanomaterial is introduced into its lattice. Compared to pure calcite, GO/calcite composite crystals exhibit lower elastic modulus and higher hardness. The results of this study show that the incorporation of a 2D material within a 3D crystal lattice is not only feasible but also can lead to the formation of hybrid crystals exhibiting new properties.

Figure 1. HAADF-STEM image of calcite with embedded GO sheets appearing as dark stripes (A), and of pure calcite showing no Z-contrast (B). Arrows indicate GO sheets entrapped within the crystal.