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Magnetically assisted assembly of bioinspired composites

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MAGNETICALLY ASSISTED ASSEMBLY OF BIOINSPIRED COMPOSITES

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Heterogeneous composites with intricate microstructures can be found widely in nature fulfilling the functional demands imposed by their environment. Reaching this level of intricacy in synthetic composites remains a challenge due to the lack of suitable and easily available processing tools. We present a new method to produce bioinspired composites with a broad variety of locally controlled composition, texture and shape using low magnetic fields. Nacre-like all-ceramic, polymer-ceramic and metal-ceramic composites with volume fractions of ceramic phase spanning from 40 to values as high as 95 vol% are achieved. By mixing magnetically responsive alumina microplatelets with ceramic nanoparticles, we can also control the amount and the density of contact points between adjacent aligned platelets in scaffold structures. Depending on the choice of the secondary phase for these scaffolds we can create composites with remarkable fracture resistance combined with interesting additional functionalities, such as electrical conductivity and temperature resistance. This technique expands the current set of processing tools for the fabrication of bioinspired composites with an unprecedented architectural control.

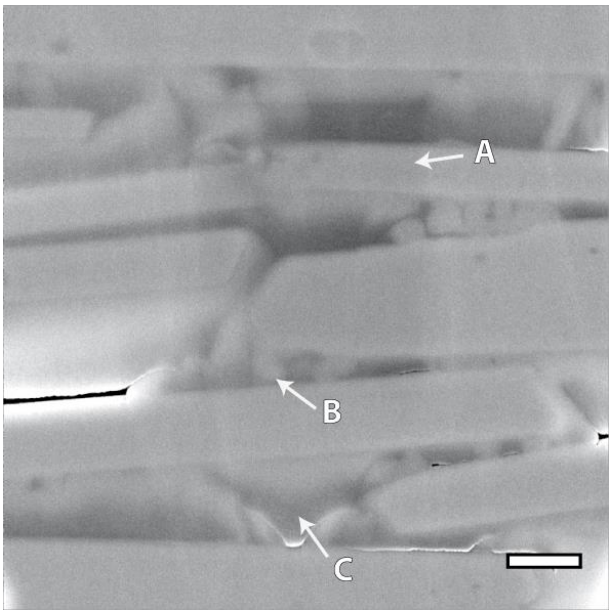

Figure 1 – Scanning electron micrograph of a nacre-like polymer-ceramic composite: A magnetically aligned alumina microplatelets, B silica nanoparticles, C polymethylmethacrylate (PMMA) used as secondary phase (scale bar 500 nm).