Hydrothrmal origin of life as an inspiration for extreme biomimetics

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The discovery of hydrothermal vents and their associated fauna, and the appreciation of their importance in the element balance has changed how we view the geological, geochemical and ecological history of the Earth [1] [2]. These unique environments possess a variety of specialized extremophiles, mainly invertebrates and microbes. Such organisms become a source for inspiration for a new direction in bioinspired materials science, known as *Extreme Biomimetics* [4-6].

Extreme Biomimetics is based on mineralization and metallization of selected biopolymers under hydrothermal conditions *in vitro*. These extreme conditions mimic natural biomineralization that occurs in submarine hydrothermal vents, and allows insight into the principles that govern this phenomenon. The key to *Extreme Biomimetics* is utilization of specific bio-macromolecules with high thermal and chemical stability. Practically all representatives of extremophile fauna contain chitin as the main structural component of their skeletons. This aminopolysaccharide is stable, even up to 400 °C [3]. Our experimental results show with strong evidence [4-7] that this property opens the key way to use chitinous matrices of poriferan origin as highly structured biological templates in a broad variety of hydrothermal synthesis *in vitro*. Here, we represent several novel approaches for the design of ZrO_2-, SiO_2-, GeO_2-, ZnO, and Fe_2O_3-based and chitin-containing biocomposites under specific hydrothermal conditions. By detailed characterization of these composite materials using a variety of advanced analytical techniques (FT-IR, Raman spectroscopy, XPS, NEXAFS, HR-TEM with SAED and FFT) we prove that *Extreme Biomimetics* is on the rise as a powerful approach for the design of a new generation of advanced nanostructured inorganic–organic materials with complex morphology and unique physicochemical properties attractive for many practical applications.

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