Biomimetics represents the most attractive approach to the design and fabrication of advanced materials, potentially improving the quality of life and decreasing the environmental footprint. The design and manufacturing of innovative materials are one of the most challenging material science endeavors. Scientists from different fields, aided by recent technologies, are striving to reach this goal. The combination of biopolymers (chitin and collagen) with inorganic nanoparticles lead to synthetic hierarchical structures that mimic natural materials, outperforming the properties of their constitutive building blocks. The combination of fundamental and applied studies at the recent biomimetics results in discoveries, and this is one of the main strengths of the biomimetics. Chitin, as well as collagen, are recognized as fundamental biomacromolecules involved in biomineralization. Both serve as templates, providing preferential sites for nucleation and controlling the location and orientation of calcium-based and silica-based mineral phases. The biomimetic synthesis of silica–collagen and silica–chitin nanocomposites, inspired by biomineralization, is still a promising direction for modern biomedicine and bone replacement. Correspondingly, a lot of attention is paid to developing the chitin-calcium phosphate, collagen-calcium phosphate, and multiphase composites like silica-collagen-calcium phosphate and their application in biomedical fields. **Thus, such chitin-based and collagen-based hybrid, bioinspired materials hold great promise in modern materials science.** A critical step in the synthesis of **collagen/mineral** and **chitin/mineral hybrids** is biopolymer solubilization. To obtain homogeneous materials, selected biomolecules (chitin and collagen) must be dissolved in a suitable reaction medium. Otherwise, rather than a true hybrid with deposition of mineral phase on all levels of structural hierarchy, the biomolecules are only coated with mineral phase.

Thus, the ultimate goal of this proposal is to **use ionic liquids and deep eutectic solvents as reaction mediums for the synthesis of biomineralization-inspired chitin- and collagen-based inorganic-organic hybrid materials.** Surprisingly, despite the wide application of ionic liquids as (i) medium in the synthesis of inorganic materials and as (ii) solvents for biopolymers, such an unconventional approach has **never been realized before** **for the synthesis of biomineralization-inspired materials. The uniqueness of this project is mainly attributable to its strong multidisciplinary character.** The proposal will bring together an array of disciplines ranging from chemistry, biochemistry, crystallography, physics, and materials science. Many analytical methods proposed in the project will allow an in-depth and complete understanding of the properties of the discussed bioinspired materials in terms of their chemical and morphological structure and assessing mutual atomic structure - porosity - mechanical properties correlations. **A holistic understanding of chemistry underlying ionic liquid and deep eutectic solvent-assisted synthesis of biomineralization-inspired hybrid materials and their technological importance can only be achieved by such a multi-faceted approach.** We are strongly convinced that the research described herewith possesses **a high degree of novelty** and **ground-breaking character. It is expected that the utilization of the adequately selected ionic liquids and deep eutectic solvents will be game-changing in the synthesis of such materials.** We anticipate that the proposed method could lead to the formation of a new generation of bio-inspired hybrids with sophisticated features, which will **outperform the natural biominerals and extend possibilities of their practical utilization in the future**. In summary, we will adopt a genuinely multidisciplinary and multi-scale approach to answer the **fundamental question:** **"*How far ionic liquids and deep eutectic solvents can push the boundaries in bio-inspired materials science?*"**