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Editorial

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Living, Social, Small and Challenging

Even considering the spectacular development that humanity has already achieved in science and technology, life still seems to be in an unreachable "divine" or "magic" realm, and biological systems continue to inspire the imagination of researchers all around the world. As the complicated network sustaining life is disentangled, the unique role of the structural organization at the atomic-molecular level becomes more and more evident. Thanks to this perception, people also realize the importance of such an organization for the development of productive interactions that generate synergy/complementarity and useful functionalities.

This special thematic issue of the *Journal of the Brazilian Chemical Society* brings together bioinorganic chemistry, supramolecular chemistry, and nanosciences, three areas that are apparently very distinct, but that have much more in common than most of us could imagine. They share common foundations and secrets still hidden in the dense fog of how the intelligent control of infinite combinations of atoms and molecules can allow us to take a step further, and deeper, in the understanding of what matter can be or become.

Since the late 1960s, bioinorganic chemistry has made great progress in elucidating complex biochemical systems and mechanisms, mostly, but not only, involving transition metals, and transposing biological systems to reach classical chemistry. These achievements have enabled a broader understanding of the functioning of metal ions in enzymes, metalloproteins, and other biomolecules, how ions are transported in living organisms, their toxicity and biomineralization, among many other fundamental issues for modern biochemistry and medicine. A clear consequence is a much deeper knowledge of life-related chemical processes.

Later, during the 1970s, another fundamental field, supramolecular chemistry, emerged from the ideas of Lehn, Cram, Pedersen, and many others, providing the toolbox needed to expand the horizons of simple molecular systems. The advent of supramolecular chemistry gave rise to the quest for understanding more complex chemical systems and phenomena. Examples are macromolecular aggregates, self-assembly, molecular recognition, long-range electron and energy transfer processes, molecular replication, host-guest systems, activation processes and catalytic reactions, including those that are stereospecific. In other words, supramolecular chemistry has allowed us to understand more clearly how two or more molecules interact with each other, and how complex molecular and macromolecular systems can give rise to new and exclusive properties in what is sometimes called "molecular sociology".

Finally, the ideas of what would later crystallize as nanoscience and nanotechnology started to develop and spread since the 1980s, mainly after the invention of appropriate tools for the investigation, and even control, of matter on a nanometer scale. These much-needed advances included the atomic force/scanning tunneling microscopes (AFM/STM) by IBM, which complemented the transmission electron microscopy (TEM)-based techniques, thus allowing the characterization and assembly of much more structurally complex materials that seemed to be outside the scope of Chemistry. Nanoscience and nanotechnology then brought to light mind-blowing findings, as well as challenges and insights to chemists. As a consequence, researchers began to understand the effect of confinement on the properties of the nanometer scale, and also how to take advantage of the still new nanoscale universe. This paved the way for the possibility of producing intelligent chemical systems by combining discrete molecular with non-discrete entities, organic and inorganic.

Needless to say, those who can understand and take advantage of these critical concepts, and navigate in each of these three areas can elevate interdisciplinarity to new grounds. Combining these concepts, the scientist becomes able to design many molecular machines, devices, sensors, advanced catalysts and drugs, in addition to energy storage and conversion systems, among many other currently relevant technologies.

The articles in this thematic issue are a contribution from researchers working in these challenging areas. The aim is to motivate and demonstrate the extent to which these concepts can lead new generations of scientists to a better understanding of nature and its numerous scientific and technological consequences.

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