



Amfiteatrul R3, FACULTATEA DE CHIMIE
2 mai 2018, ora 15:00

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Perspectives in Chemistry: Molecular – Supramolecular – Adaptive Chemistry

Molecular chemistry has developed a wide range of very powerful procedures for mastering the organisation of matter and building ever more complex molecules from atoms linked by covalent bonds.

Supramolecular chemistry lies beyond molecular chemistry. It aims at constructing and implementing highly complex chemical systems from molecular components held together by non-covalent intermolecular forces. It relies on the development of pre-organized molecular receptors for effecting *molecular recognition*, catalysis and transport processes, on the basis of the *molecular information* stored in the covalent framework of the components and read out at the supramolecular level through specific interactional algorithms.

A further step consists in the design of systems undergoing *self-organization*, i.e. systems capable of spontaneously generating well-defined functional supramolecular architectures by self-assembly from their components, thus behaving as *programmed chemical systems*. Chemistry may therefore also be considered as an *information science*, the science of informed matter.

Supramolecular chemistry is intrinsically a *dynamic chemistry* in view of the lability of the interactions connecting the molecular components of a supramolecular entity and the resulting ability of supramolecular species to exchange their components. The same holds for molecular chemistry when the molecular entity contains covalent bonds that may form and break reversibly, so as to allow a continuous change in constitution by reorganization and exchange of building blocks. These features define a *Constitutional Dynamic Chemistry* (CDC) covering both the molecular and supramolecular levels.

CDC introduces a paradigm shift with respect to constitutionally static chemistry. It takes advantage of dynamic diversity to allow variation and selection and operates on dynamic constitutional diversity in response to either internal or external factors to achieve *adaptation*.

The implementation of these concepts points to the emergence of *adaptive and evolutive chemistry*.

References

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