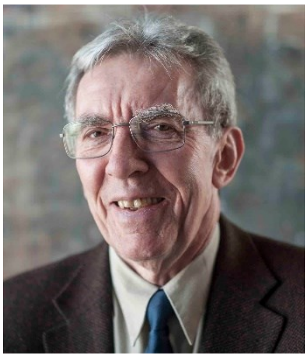
Invited Nobel Prize Laureate:

Topology and Molecular Machines: Two Interlinked Research Fields

Jean-Pierre Sauvage
Institut de Science et Ingénierie Moléculaire (ISIS). International Center for Frontier Research in Chemistry, University of Strasbourg, France, jpsauvage@unistra.fr



Prof. Jean-Pierre Sauvage Since the beginning of the 80s, Sauvage and his group have been interested in various fields including : (i) coordination photochemistry and solar energy conversion, (ii) CO_2 electrocatalytic reduction, (iii) chemical topology : catenanes, knots and rotaxanes, (iv) multifunctional ruthenium and iridium complexes for light-induced charge separation, (v) multifunctional porphyrins as models of the photosynthetic reaction centre as well as (vi) molecular switches and molecular machine prototypes such as a "swinging catenane", "muscles" or "compressors". Sauvage received many awards at the international level, including the **2016 Nobel Prize in Chemistry.** He has also been invited as a name lecturer in many universities all over the world. He worked with a group of wonderful professional and nonprofessional co-workers who were mostly responsible for the scientific success of the team. Their work has been cited numerous times.

Sauvage Home Page https://isis.unistra.fr/laboratory-of-inorganic-chemistry-jean-pierre-sauvage/

ABSTRACT

The area referred to as "Chemical Topology" is mostly concerned with molecules whose molecular graph is non-planar, i.e. which cannot be represented in a plane without crossing points. The most important family of such compounds is that of **catenanes**. The simplest catenane, a [2]catenane, consists of two interlocking rings. **Rotaxanes** consist of rings threaded by acyclic fragments (axes). These compounds have always been associated to catenanes although, strictly speaking, their molecular graphs are planar. **Knotted rings** are more challenging to prepare. Several spectacular knotted topologies at the molecular level have been created since the beginning of the 90s either by our group or by other highly creative research teams.

Since the mid-90s, the field of **artificial molecular machines** has experienced a spectacular development, in relation to molecular devices at the nanometric level or as mimics of biological motors. In biology, motor proteins are of utmost importance in a large variety of processes essential to life (ATP synthase, a rotary motor, or the myosin-actin complex of striated muscles behaving as a linear motor responsible for contraction or elongation).

Many examples published by a large number of highly creative research groups are based on complex rotaxanes or catenanes acting as switchable systems or molecular machines. Particularly significant examples include a “pirouetting catenane”, “molecular shuttles” (Stoddart and others) as well as multi-rotaxanes reminiscent of muscles. More recent examples are those of multi-rotaxanes able to behave as compressors and switchable receptors or as molecular pumps. The molecules are set in motion using electrochemical, photonic or chemical signals. Particularly impressive light-driven rotary motors have been created by the team of Feringa.

Finally, potential applications will be mentioned as well as possible future developments of this active area of research.

General References

[1] “Ruthenium(II) and Osmium(II) Bis(terpyridine) Complexes in Covalently-Linked Multicomponent Systems: Synthesis, Electrochemical Behavior, Absorption Spectra, and Photochemical and Photophysical Properties”; Jean Pierre Sauvage, Jean Paul Collin, Jean Claude Chambron, Stephane Guillerez, Christophe Coudret, Vincenzo Balzani, Francesco Barigelletti, Luisa De Cola, and Lucia Flamigni; *Chemical Reviews*, 1994, 94(4), pp. 993–1019

[2] “Transition Metal-Containing Rotaxanes and Catenanes in Motion: Toward Molecular Machines and Motors”; Sauvage, J.-P.; Accounts of Chemical Research, 1998, 31(10), pp. 611–619

[3] “Shuttles and muscles: Linear molecular machines based on transition metals”; Collin, J.-P., Dietrich-Buchecker, C., Gaviña, P., Jimenez-Molero, M.C., Sauvage, J.-P.; Accounts of Chemical Research, 2001, 34(6), pp. 477–487

[4] “Chemical topology: Complex molecular knots, links, and entanglements”; Forgan, R.S., Sauvage, J.-P., Stoddart, J.F.; Chemical Reviews, 2011, 111(9), pp. 5434–5464