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Supramolecular chemistry with Jean-Marie Lehn

"Supramolecular chemistry can help to understand better how to make efficient drugs"

On the occasion of the II Doctoral Seminars, organised by the UAB Department of Chemistry, Nobel Laureate Jean-Marie Lehn, who received the Nobel Prize in Chemistry 1987, visited our university to give a speech on the design of supramolecular nanostructures and their applications. Taking advantage of his visit, UABDivulga interviewed him to learn more about supramolecular chemistry, the boundaries between life and non-life and the impact of receiving the Nobel Prize.

Jean-Marie Lehn, professor emeritus at the University of Strasbourg, was born in Rosheim, France, in September 1939. In 1987 he was awarded with the Nobel Prize in Chemistry for his molecular recognition studies. For these investigations is considered one of the fathers of supramolecular chemistry. In addition to further research, Lehn has also participated in activities of popularization of science in which, in his words, try to show "what scientists are doing and why they are doing it".

What is supramolecular chemistry?

To explain what is supramolecular chemistry one has to start from the beginning. Chemistry deals with structure and transformation of matter. So, molecular chemistry is the study of the entities one gets by combining atoms to get molecules. Supramolecular Chemestry is a step beyond, addresses how molecules interact with each other. Among these interactions, molecular recognition, which is very important, is the way that molecules can recognize each other. All the functions in a living organisim, like a human being, start with recognition between molecules, and therefore there are at a supermolecular level. For the general public, I often say that molecules are like individuals, so molecular chemistry deals with individuals. And supermolecular chemistry deals with the society. Supermolecular chemistry is a chemical sociology, so to speak.

Is supramolecular artificial life possible?

We are far from making artificial life. I am convinced that life is a chemical process. Living systems happen to develop or organize themselves with chemical processes, all living systems are based on molecules. We will progressively understand how life has appeared from the molecular world, to go from the molecular world to the supermolecular and then to more complex states of matter. Supermolecular chemistry is useful to understand, progressively, how a living system can form out of the non-living world.

When can we say then that something is alive or dead?

I think the boundary still exists of course. There is quite a difference in something which is living and something non-living. Some entities are just in the interface, like a virus. A virus is an assembly of molecules that is not living when it is outside of a cell but when it goes inside it can reproduce itself and begins to life so to say… They are sort at the boundary. Progressively, one has to define what life is and what the characteristics of life are, but I am convinced that this will be done.

What practical applications does it or will it have?

The supermolecular chemestry has had already a large number of applications. One can mention making sensors, or specific recognition of compounds like in a biological organism or making new types of material, making drugs… a pharmaceutically active compound is a molecule which interacts with a biological target, so it has to recognize the biological target… So, one application is to understand better how to make efficient drugs.

Can these practical applications, this nanomanipulation, be dangerous?

Everything is dangerous if you misuse it. Depending on what you call dangerous. The invention of the wheel was the worst invention. All car accidents come from the fact that wheels exists. If you have no wheels, you have no cars, and you have no car accidents. So, if you don’t know how to drive your car then you have car accidents. So, nanotechnologies are big progress in science but we have to learn how to use it, how to drive the car. And not only nanotechnology, we have to learn how to use science in general.

You talk of a strong component of creativity in supramolecular chemistry. How can art and

science interact?

This is not supramolecular only, is chemistry in general. This is one reason I came to chemistry. Because I felt, many years ago, that chemistry is a very creative science. You can make things which never existed before, which is a characteristic of art. A major characteristic of art is to generate something which is a new expression of sound (music), of colors (painting), of hard materials (statues)… and chemistry has this ability. And much more profound in fact, because chemistry deals with elements making up matter and can make new expressions with this elements, can generate very different types of objects from the ones we know around us and in that respect I think that chemistry, as I often call it, is the art of matter.

What are the differences between supramolecular chemistry and adaptive chemistry?

We have now the extension of supramolecular chemistry that is what I call adaptative chemistry it is sort of a natural evolution, going from molecules which deal with isolated entities, to supramolecular chemistry which deals with assemblies and then making these assemblies able to respond to external stimulations which make them adaptive. So, I think it's a normal extension getting more and more complex structures. And this is the normal evolution from a very simple things, like atoms to more and more complex like molecules or supramolecular structures and adaptive systems and so on…

Has winning the Nobel Prize changed your life?

It makes it in some respects more easily and in other respects more complicated. You get many more invitations, many more interviews… but in the whole is a very interesting experience. To illustrate science, usually I do not say to defend science or chemistry, they don't need that. They stand by themselves. I rather prefer to say illustrate science. To show people, the general public, those who are not specialists, what scientists are doing, why they are doing that.

Do you think that popularization is important?

Yes, I think that it is very important, it is also important to have people to transfer this knowledge. Media have a very important role to play there, and they have to play it well and not just to sometimes amplified things that should not be amplified or being biased. Is much easier to play on fear of people rather that to play on hope, to illustrate what is good. In the newspapers you find all the accidents, but you don't find everything that works. You can easily find that somebody has been crashed by a car while crossing the street but you don't find the hundreds of people that has crossed the street without been crashed by a car.

Miquel Carandell Baruzzi
premsa.ciencia@uab.cat

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