Internet of functions in hybrid supramolecular nanomaterials

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Nowadays, Internet of Things is becoming a leitmotiv in our daily life, the latter being characterized by interconnected macroscopic tools and technologies thereof operating 24/7. On the nanoscale, one among the greatest challenges in chemistry consists in the development of artificial Complex Chemical Systems with functions that are getting more and more sophisticated and interconnected among each other.

In my lecture I will review our endeavor on the use of supramolecular chemistry approaches towards the development of multicomponent assemblies comprising low dimensional nanostructures. In particular I will discuss our recent results on:

1) imparting multiple functions to organic electronic devices via the combination of carbon-based nanomaterials, especially organic semiconductors, with photochromic molecules (diarylethenes or azobenzenes) in order to realize smart, high-performing and light-sensitive (opto)electronic devices [1] as well as flexible non-volatile optical memory thin-film transistor device with over 256 distinct levels.[2]

2) interfacing molecular science with 2D materials, by mastering covalent and non-covalent approaches,[3] in order to tune of the dynamic physical and chemical properties of 2D materials, by imparting them novel functions,[4] with the ultimate goal of generating responsive thus multifunctional hetero-structures.[5]

3) the tailoring of low-dimensional nanostructures chemically functionalized by the receptors of the target analytes and on the use of these hybrid assemblies to fabricate chemical sensors (e.g. humidity) combining high sensitivity, selectivity, response time and reversibility.[6] Finally, I will describe how the same approaches can be exploited to realize highly sensitive pressure sensors which can monitor heartbeats, thus holding great potential for their integration in medical diagnostic devices or sport apparatus.[7]

Our approaches provide a glimpse on the chemist's toolbox to generate multifunctional hybrid materials based with ad-hoc properties to address societal needs in electronics, sensing and energy applications.

References

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