# Editorial

Anne-Sophie Chauvin

Michael Grätzel

We are now accustomed to hearing about sustainable and renewable energies, and the future of our planet is a concern for the whole society. But what does it mean for us as scientists? What efforts have to be made to bring an effective and tangible solution for future generations? Solar energy is definitely a determinant and 'brilliant' source for various applications, bringing alternative solutions to the energy frontier. A lot has already been done, but so far this domain is far from being completely explored. Efforts are still to be made before we achieve an ideal use of the quasi-inexhaustible solar resource. The concept of energy conversion for light harvesting or for fuel production is certainly of utmost interest and new developments are expected in the coming decade. Expectations are high in terms of devices able to produce energy with good efficiency, but other issues are also very important, such as daily and seasonal storage.

Many research laboratories are considering these questions, and are trying to develop concrete solutions. Let's take the example of a dye-sensitized solar cell (DSSC). This latter consists of a nanostructured thin-layer with a wide band gap semiconductor film; a dye is adsorbed at its surface and regenerated in presence of a redox system. Which competences and expertise are necessary to develop such a device? Here we tentatively try to answer to some of these questions, thanks to experts of various domains who have kindly accepted to contribute to this special issue of CHIMIA, and we are grateful to their participation! Before being synthesized, a dye has to be designed in such a way that it answers some criteria in terms of planarity, redox properties, *etc*. The contribution of computational chemistry is determinant to design these new dyes. They can be organic dyes or metal-based compounds, mainly Ru complexes. For instance, what do we know about the influence of cyclopentadithiophene (CPDT) linkers being incorporated into acceptors-bridge-donors systems (the so-called D-π–A dyes) based on triarylamines (*Climent and Casanova*) or about the Ru-containing black dye (*Fantacci, Lobello and De Angelis)*?

Once it has been designed, much effort is being made to synthesize the dye, which has to be soluble, and stable before being further exploited. Heterocyclic chemistry, above all, is then a concern for the organic chemistry community. Among the dyes of interest, some may absorb in the NIR range or be panchromatic (*Park, Viscardi, Barolo and Barbero*). The dyes will be used to build the solar device.

Construction of a solar cell, however, does not consist in a simple dipping process of the nano-structured $TiO_2$ thin-layer in the dye solution. An intrinsic and complex mechanism takes place: the structure of the mesoporous titania phase, its morphology and thickness (*Lin, Wang, Hao*), the way the dye fills the pores, and the mode of coordination of the donor part of the dye to the surface are some of the elements which are determinant for the electron separation and injection of the electrons to the conduction band. The efficiency of the dye will be a direct consequence of these processes. Expertise in surface phenomena is required to develop efficient devices (*Hagfeldt and co-workers*). It also implies the development of new redox systems and solid-state systems whereby the influence of the redox system is essential for the regeneration of the system (*Krysova, Zukal, Trckova-Barakova, Chandiran, Nazeeruddin, Graetzel, Kavan*).

The device can have different applications dealing with conversion of solar energy into chemical fuels (*Sivula*) or for light harvesting. Photocatalytic water splitting for $H_2$ production is also a main concern (*Pokrant, Mägli, Chiarello, Weidenkaff*) and a simple material such as hematite can bring interesting possibilities (*van de Krol, Liang*).

The strategies applied in academia do not necessarily adhere to the expectations of industry. A solar cell can be obtained in our labs, with an efficiency of more than 10% and surface area about 1 $cm^2$. Will we be able to achieve the same efficiency when producing such cells at the industrial scale, with much larger surfaces? It will depend on how the academic and industrial domains collaborate to share the information, and how the technology is transferred to industry (*Meschter*). An example of such application is the incorporation of the DSSCs in the windows of the congress centre currently being built at EPFL (*Barraud*).

We believe that solar energy conversion is still of increasing interest and will attract more and more researchers in a near future. We hope that young researchers will find a source of inspiration by reading this special issue of CHIMIA, and that the scientific community will enjoy the multidisciplinary aspects of this topic.

Anne-Sophie Chauvin and Michael Grätzel
EPFL SB ISIC LPI
CH-1015 Lausanne

---

The Editorial Board of CHIMIA expresses its appreciation to the coordinating guest editors Dr. Anne-Sophie Chauvin and Prof. Michael Grätzel for their efforts in the planning and realization of this very interesting and informative issue on Solar Energy Harvesting.