PRESS RELEASE

Casting sunlight on desired reactions

The production of chemicals is still dominated by the use of stirred-tank reactors. This large scale industry approach is limiting the viability of the product spectrum while not even being designed for saving resources. Green Chemistry is the magic word in this context. Using light as activating energy can complement the conventional thermal path by a photochemical route. This will open the supply of a variety of complex chemical compounds. In the context of the Green Chemistry sustainability principles Fraunhofer ICT-IMM is implementing photochemistry as an important synthesis route for its future industrial applications.

The conventional production of chemicals in large quantities causes huge amounts of waste or byproducts respectively. Additionally, many commodities in chemical industry are crude oil based – definitely not a renewable resource. Green Chemistry follows the approach to contain environmental pollution, save energy and produce in an environmentally friendly manner. So, which alternative methods are available or can be developed?

Photochemistry comprises a class of chemical reactions that are initiated by the interaction with light. Mostly, they take place at room temperature and normal pressure. Such sustainable and environmental friendly conditions allow achieving reagents and secondary products which can hardly be realized with thermal treatment. As such, photochemistry is a viable alternative to realize syntheses in a non-thermal way.

Up to now it is virtually impossible to perform photochemical reactions at large industrial scale. A conventional "vessel" containing any kind of solution simply cannot be irradiated uniformly enough so that a reasonably controlled process could be achieved. This is why ICT-IMM has brought its microreactor technology into play which allows the light to completely penetrate a thin layer of solution on its way through the reactor. Moreover, the temporarily defined residence time enables more precise control of byproduct formation.

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ICT-IMM's scientists see their tasks in „translating" academic research for industry into practical applications. „At the moment we are working on the upscaling of our existing methods", explains Dr. Thomas Rehm. The scientists have successfully proved the production of singlet oxygen by means of their falling-film reactor. Singlet oxygen plays an important role in the production of active pharmaceutical ingredients, such as Artemisinin used for the treatment of infectious diseases. Consequently, it is planned to test larger reactors with larger windows respectively which will yield a larger area for light irradiation. Currently the light is of artificial origin which should ultimately be replaced by sunlight following the concept of sustainability.

The long-term goal of course includes as well the aspect of cost-saving. This is quite evident taking into account that expensive reagents are not required, the reaction can take place at standard temperature and pressure and, thus, no enhanced safety regulations need to be in place. One targeted user group comes from pharmaceutical industry thinking in the direction of photochemical synthesis of fluorinated compounds. Their range of application covers the lowering of the cholesterol level, the application as sleep-inducing drugs and sedatives as well as current antibiotics. Additionally, silver nano particles could be successfully produced. Due to their bactericidal properties they are as well applied in medicine.

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