ISGC 2019 May 13rd - 17th

N°935 /
TOPIC(s) : Industrial chemistry

Going Beyond Fossil Fuels for Next-Generation Green Chemical Production

AUTHORS

Gabriele CENTI / UNIV MESSINA, DEP MIFT (IND. CHEMISTRY), UNIV MESSINA, MESSINA
Siglinda PERATHONER / UNIV MESSINA, DEP MIFT (IND. CHEMISTRY), UNIV MESSINA, MESSINA

PURPOSE OF THE ABSTRACT

Low-carbon production has been often considered just a socio-political driver to mitigate climate change and secure/diversify the energy resources. This lecture will remark how instead economic and innovation motivations will be key factors for the transition to a new energy-chemistry nexus and chemical production, a process that is already on going. The main impact on chemical production of this trend is the need to change the production model: from fossil fuels as C-source and especially energy source (the major use of fossil resources in chemistry, to produce the heat driving largely the current way to provide energy for chemical transformation and related separation units) to the use of alternative C-sources in strong symbiosis with the use of renewable energy sources. A consequence is that the current production model, based on the economy of scale and large plant sites (suffering today of many environmental and societal issues) due largely to the need of heat integration, will be changed to a distributed model, with easy scalable (parallelized approach), faster time to marked and high flexible processes. The new production model overcomes a current main limit in chemical production, which translated in a very low rate of introduction of new chemical processes (and novel catalysts) in the last decade. In fact, large uncertain in predicting future economics and fossil resource costs, together with high investments and long-term amortization, determine a low incentive to invest in new processes and low competitiveness. A distributed model will favor new investors and create a positive impact on innovation.

Changing the economic model of chemical production will thus have not only an impact on environment, with also other positive aspects on local communities, but on the innovation side. Already today, we are close to the conditions in which invest in the new economic model (based on alternatives to fossil resources and distributed production) will be more convenient than on the traditional one, with the main limit today is a delay in the development of the necessary technologies, with electrified chemical production, e.g. use of electrical energy as main source for the process, being one of the key elements. Clearly, this has major consequences in terms of catalysts needs for this transition.

In parallel, another major factor that will characterize this transition is that the implementation of a renewable energy economy requires, as crucial element, the possibility to produce renewable energy in remote areas, and thus to realize (liquid) chemical energy storage vectors which can easy transport energy from long distances and stored for seasonal/yearly uses, as currently made with oil and derivative energy vectors (gasoline, etc.). This is the main concept of Power-to-X, even if currently used in the more limit approach of storage of excess renewable energy, produced for example during night. In terms of chemical production, this will imply the availability of new low-cost and low carbon (if produced in association with waste utilization) raw materials, methanol for example. This has major consequences on both future schemes of refinery and (petro)chemical production, with also a consequent change in catalysis needs. Electrified chemical production poses new challenges for catalysis.1

There are thus major changes expected in chemical production and associated nexus with energy deriving from this transition, with the need to develop a new vision for chemical production and catalysis to address properly this change,2 but also new conceptual tools (for example, in the area of chemical engineering3) to properly analyze this transition. The lecture will first analyze the scenario opened from this transition to a new (sustainable and low carbon) chemistry and energy, in relation to the change in their nexus and related influence on economics. It will

then shortly discuss some options for a short, medium and longer term change. For short term, the use of waste as alternative C-source is discussed,[4] with an analysis of the waste to chemical possibilities and an analysis of the role of chemical energy storage to enable the transition to a renewable-energy-driven economy. For medium- and longer-term, the possibilities for electrified chemical production, with some aspects on the combination between plasma and catalysis, is analyzed to focus then discussion on electrocatalysis,[5] evidencing especially the opportunities in terms of process intensification for biomass conversion, creation of CO_2 value chain and ammonia direct synthesis.[6,7]

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

BIBLIOGRAPHY