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(I) Plasma-catalysis: From catalyst synthesis to control of plasma chemistry

Tuesday 7 June 2022 08:30 (30 minutes)

Plasma provides the unique processing conditions for the synthesis of nanocatalysts and gas conversion, as well as the direct coupling of renewable electricity with chemical processing. Catalysis unlocks efficient reaction pathways and enables the performances necessary for process industrialization. Both combined provide unique avenues for chemical process electrification, an essential transition vector of the sustainability transition. Over the last twenty years, our laboratory has developed elementary units and accompanying processes linking the green electron from the electrical outlet to the green chemical and process of the energy transition. The journey begins with electrical power supply and reactor design to achieve uniquely controlled plasma chemistry. I will describe our recent work on nanosecond-radiofrequency (RF) plasma sources for transient/repetitive plasma generation under the challenging conditions of reactive gas mixtures and pressures above atmospheric. I will describe how pulsed laser ablation combined with RF plasma functionalization is used to synthesize unique nanocatalysts with reduced environmental footprint. Preliminary results with the dry reforming of methane and ammonia synthesis will be presented. In the second part of the talk, I will introduce the limits of the state-of-the-art gas conversion plasma reactor technologies and introduce promising opportunities enabled by topological design and recent advances in additive manufacturing. These novel approaches pave the way to plasma process intensification via reactor miniaturization, parallelization and integration.

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