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Plasma chemistry in the search for new gas processing methodologies

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In 1857, Siemens proposed a new type of electrical discharge with the aim of generating ozone from air at atmospheric pressure. The experimental device basically consisted in two electrodes fed by an alternating voltage and separated by a dielectric barrier. At high enough voltages plasma ignited and chemical reactions took place in the gap between the electrodes. This simple idea brought up a new procedure which has made possible plasma-chemical reactions at standard conditions. During the 90's applications of DBD (Dielectric Barrier Discharge) were mainly focused on pollution control and the aforementioned ozone production. Recently, DBDs is being used for the synthesis of high valuable chemical (formaldehyde, ammonia, hydrogen, etc.) as well as for reforming of hydrocarbons. The mild operating conditions (atmospheric pressure and room temperature), the low power required and the synergetic effects in combination with catalytic processes (catalyst can be incorporated as a part of the dielectric barrier) make DBD a promising tool for gas processing technologies. A way of increasing the efficiency and chemical yield of those plasma reactions is by controlling the plasma operating parameters and the reactor architecture. For instance, it has been recently demonstrated that, in packed-bed DBD reactors where the barrier is constituted by small pellets, replacing classical dielectric materials by ferroelectrics contributes to notably increase the efficiency of the discharge. In this talk, we discuss the last advances in the field of DBD plasma chemistry, with special attention to the reactor performance and focusing on ammonia production, VOCs removal and methane reforming processes.

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