

## The challenge of identifying plasma catalysis mechanisms

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The combination of plasma chemistry processes with catalytic surface reactions has the great potential to lead to very flexible and robust plasma conversion schemes. By combining plasma and catalysis, the energy efficiency, the conversion rates, the actual optimum temperature window and the selectivity of the process can be enhanced. Especially the selectivity of a plasma conversion process can be enhanced by a very selective surface process. The identification of a plasma catalysis synergism is, however, extremely challenging, because the isolation of a particular process is very difficult. At the plasma surface interface, many species such as ions, radicals, electrons, and photons interact simultaneously on top of a plasma-induced heating or a plasma-induced surface modification. Therefore, this question has been mostly addressed by modeling either on a very fundamental level by using ab-initio quantum mechanics or molecular dynamics to calculate the rate of particular surface reactions. In addition, microkinetic modeling of the complete plasma process is employed, where the surface process can often only be estimated. Moreover, the typical plasma chemistry test system is a dielectric barrier discharge packed bed reactor, which is very similar to a conventional reactor for thermal catalysis. Such a DBD reactor, however, has a very heterogenous filling with plasma and beads and any local heating effects, for example, can not easily be excluded to explain any synergism when combining plasma and catalysis. In this presentation, a different approach is taken. By using a well defined RF plasma, where the molecules of interest are diluted in a noble gas stream, the chemistry can be reduced and the temperature of the catalyst surfaces and of the molecules can be controlled. This is used to analyze the appearance of plasma catalysis mechanisms for CO<sub>2</sub> splitting and for CH<sub>4</sub> and n-Butane oxidation.