Plasma catalytic CO$_2$ hydrogenation into valuable products

Non-thermal plasma is a promising medium in which to perform catalytic reactions. Collisions with high energetic electrons in plasma result in ionization and dissociation, and electronic, vibrational, and rotational excitations of neutral reactant molecules. Current mechanistic understanding of the synergy between heterogeneous catalysts and plasma is very limited. The main issue is that effective comparison between different catalysts is extremely difficult. This is because the properties of the plasma depend on the filling material (catalyst) and vice versa, i.e. permittivity and polarization of the catalyst is determined by the plasma parameters. Therefore, novel characterization methods have to be developed in order to understand the synergism in plasma-catalysis. **Temperature programmed plasma reaction (TPPR)** that allows to uncouple the gas-phase processes from the plasma-induced surface processes and to properly compare the performance of plasma-catalysts. Furthermore, optical emission spectroscopy is applied for plasma diagnostics, UV-Vis spectroscopy for online monitoring of the catalyst temperature and in-situ DRIFT spectroscopy to distinguish the difference between intermediate species of CO$_2$ hydrogenation during conventional and plasma-catalysis.

The understanding of these issues will lead to further promoting of the application of non-thermal plasma combined with heterogeneous catalysis.

**Main goals of the project are:**

- Developing new methods in plasma catalysis in order to understand apparent synergy of catalyst and plasma;
- Synthesis of novel catalytic system for plasma catalysis.

**The skills you’ll get:**

- Catalysts testing in plasma environment: GC, MS, oscilloscope, optical emission spectroscopy
- Mechanism studying: Operando DRIFT and UV-vis, fluorescence, RAMAN
- Catalysts preparation: zeolites synthesis, sol-gel, impregnation, co-precipitation
- Catalyst characterization: XRD, XPS, BET, TEM, SEM, TPR, FTIR

**For further information**
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