Plasma-enhanced catalysis of CO_2 as a new concept of electricity-driven chemical reaction

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CO_2 methanation is an important carbon utilization technology. However, high temperature is necessary to dissociate C=O bond of CO_2, while low-temperature is needed to associate multiple C-H bonds of CH_4. It is hard to overcome such temperature miss-match because the reaction is fully dominated by thermodynamics. Nonthermal plasma catalysis would provide a promising solution enabling low-temperature catalysis of CO_2 while renewable electricity is utilized efficiently.

The presentation highlights the combination of dielectric barrier discharge (DBD) and bimetallic alloy catalysts (Pd_2Ga/SiO_2) which induce strong synergism where the CO_2 conversion increased beyond thermal equilibrium. The main topics are (1) Kinetic analysis of plasma-catalyst reaction using a newly developed fluidized-bed DBD reactor. (2) Quantifying the apparent activation energy. (3) Density functional theory analysis to support kinetic analysis and identifying the rate-determining step. (4) The transient *in situ* infrared absorption spectroscopy of intermediate surface species and their reaction behavior. (5) IR absorption spectroscopy of vibrationally excited CO and CO_2 (tentative).