Plasmon-Induced Reverse Water Gas Shift (RWGS) Reaction by Cu Nanoparticles & Tuning Zeolites for Plastic Degradation

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Abstract:

Photocatalytic reduction of carbon dioxide (CO_2) by solar light has the potential to facilitate the renewable production of storable fuels. Localized surface plasmon resonance (LSPR) allows some metal nanoparticles (NPs) to harvest visible light and concentrate it near the nanoparticle surface, to produce excited charge carriers. Plasmonic catalysts used these energetic charge carriers (and photothermal heat) to drive chemical transformations on their surface and allowed the more selective reaction pathways that were not possible in thermal catalysis [1-2].

In this work, we have synthesized plasmonic copper catalysts by loading Cu NPs on Dendritic Fibrous Nano Silica (DFNS) which absorbs broadband solar light from visible to near IR. Conversion of CO_2 to CO took place as soon as the catalyst was exposed to light. No external heating was required. Photoexcitation and activation of CO_2 and H_2 were achieved by LSPR of Cu. The photocatalytic CO_2 hydrogenation activities of the DFNS/Cu were found highest among the reported ones with better selectivity. Notably, the reaction was carried out at room temperature and atmospheric pressure without external heating in a flow reactor. Linear dependence of CO production rate on light intensity indicated the non-thermal hot-electron mediated CO_2 reduction. In-Situ diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) showed that CO_2 hydrogenation took place by direct dissociation.

In the second project, we studied Zeolites, where microporous & mesoporous structures were developed by means of post-synthesis modification, as pyrolysis catalysts of different sources of plastic waste [3]. The plastic wastes were, classified as LDPE, HDPE & polypropylene. These plastic waste mixtures were extruded with the catalyst and thermogravimetric analysis was performed. We observed a decrease in degradation temperatures, in catalytic pyrolysis compared to non-catalytic thermal pyrolysis. Then we investigated the role of the Acidity of these materials in plastic degradation.

References:

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