Abstract

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Discretization of the Catalyst Sites by Encapsulation of Palladium inside the Cavity of Crown Ether within the Interlayer of Layered Double Hydroxide for Enhanced Activity: A case study with Hydrogenation Reaction

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Abstract

The intrinsic activity of the noble metal-based heterogeneous catalysts is limited by weak metal-support interactions, aggregation and low surface to volume (S/V) ratio. One of the techniques to augment the catalyst activity is the discretization of the active sites and redistribution of electron density around the metal atom. In this work, these two phenomena are studied to enhance the catalytic activity concerning a model reaction, hydrogenation of p-Nitrophenol (p-NP). Herein, 15-crown-5 ether is introduced in the basal space of layered double hydroxide (LDH) to encapsulate noble Pd0 inside the cavity of the crown molecule, strategically. The modified LDH (Pda-ECC-L0.10@In-situ CoAl LDH) augmented the properties, like, high S/V ratio and non-aggregation of active sites by forming discrete nanometer sized catalyst sites within the cavity of crown ether in the interlayer. Formulation of these discrete active sites are well explained by X-ray diffraction (XRD), Transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS) and Fourier transform infrared spectroscopy (FTIR) characterizations. The developed catalyst exhibited higher turnover frequency (TOF) demonstrating the improved activity due to the discretized Pd sites and redistributed electron density around the Pd by LDH layers and crown molecules with non-compromised activity till 15 cycles. Thus, the present material synthesis route can be considered as a stand-alone method for preparation of the supported sub-nanometer noble metal catalyst with higher activity and can be exploited for similar kind of reactions, where noble metal catalysts are used.

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Biography

Shanmuk S Ravuru has done his Masters from National Institute of Technology Bhopal and Bachelors from MVGR college of Engineering. Currently his expertise includes synthesis and functionalization of nanomaterials and application of them for various industry associated unit operations, alongside community scale water treatment. He is a skilled material scientist with hands on experience on synthesis of Metal Organic Frameworks (MOFs), Layered Double Hydroxides (LDHs) and Zeolite Imidazole Frameworks ZIFs). Being an academician in core and based on his open and contextual evaluation, he gained ample experience in finding out solution to many industrial and environment concern problems.

