UNLOCKING THE POTENTIAL OF IRON-LOADED ZnO FOR ENHANCED CO_2 CONVERSION A COMPARATIVE INVESTIGATION USING HYDROTHERMAL AND WET IMPREGNATION METHODS

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Abstract

In the present work, iron-doped zinc oxide nanocomposites (ZnO-FeOx) were synthesized by two different routes i.e. hydrothermal and wet impregnation for the photocatalytic CO_2 reduction under both visible-light irradiation (VLI) and UV-light irradiation (UVI). The results indicated that the ZnO-FeOx samples exhibited defects as a result of doping in the hydrothermal method, while heterosystem was observed in the case of wet impregnation route. The wet impregnation nanocomposites showed remarkable results and produced CO with a yield of **2.418** μmol/gcat (VLI) and **1.725** μmol/gcat under (UVI). In contrast, the hydrothermal method yielded **0.477** μmol/gcat and **0.36** μmol/gcat of CO under (UVI) and (VLI). These outcomes represent approximately tenfold (wet impregnation) and sevenfold (hydrothermal) improvements compared to bare ZnO. Various factors were thoroughly examined which contributed to the enhanced performances of (ZnO-FeOx) as compared to pristine ZnO. Theoretical investigations using density functional theory (DFT) unveiled the presence of novel impurity energy states in ZnO caued by iron. Furthermore, diffuse reflectance infrared fourier transform spectroscopy (DRIFTS) identified the critical intermediates. Additionally, the study elucidated a charge transfer mechanism involved in photocatalytic CO_2 reduction.

Keywords: *Photocatalysis, CO_2 reduction, RWGS, UV/Visible light irradiation*