Synthesis of green ammonia from Cl-doped nano-Fe2O3: the role of interfacial segregation

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The utilization of solar-driven photoreduction for ammonia production presents a promising alternative to the energy-intensive Haber-Bosch method. The possibility of using solar light during this process offers a greener and more energy-efficient pathway. Among the materials used for this application, iron oxide emerges as a viable option due to its abundance and low toxicity. However, iron oxide also presents a low charge transfer, a short diffusion length, and a high electron-hole recombination rate [1]. Thus, one of the strategies to mitigate this problem is doping iron oxide with ions that can increase the recombination time of the electron-hole pair and consequently improve its photocatalytic performance. In this study, Fe2O3 and Cl-doped Fe2O3 nanoparticles were synthed using a modified polymeric precursor method [2]. The segregation of Cl ions at the interfaces of Fe2O3 was confirmed through selective lixiviation. Subsequent analysis using electrochemical impedance spectroscopy (EIS) revealed a significant reduction in electric resistivity in the doped samples, attributed to grain boundary segregation of Cl, facilitating electron and hole transport. Finally, the ammonia production using Fe2O3 and Cl-doped Fe2O3 nanoparticles were evaluated in a reactor under UV light.

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References

[1] H. Liang, X. Jiang, W. Chen, S. Wang, B. Xu, and Z. Wang, Ceramics International, vol. 40, no. 4, pp. 5653-5658 (2014).
[2] P. A. Lessing, American Ceramic Society, vol. 68, pp. 1002-1007 (1989).