SINTESIS NANOPARTIKEL TiO_2 DIDOPING NITROGEN DENGAN SUMBER NITROGEN DARI KITOSAN LIMBAH KULIT UDANG UNTUK FOTOPRODUKSI HIDROGEN

SKRIPSI SARJANA KIMIA

Oleh :

Nurhasni

NIM : 2110412003

Dosen Pembimbing I : Dr. Diana Vanda Wellia, M.Si

Dosen Pembimbing II : Prof. Dr. Zilfa, M.S

PROGRAM SARJANA

DEPARTEMEN KIMIA

FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM

UNIVERSITAS ANDALAS

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ABSTRACT

Synthesis of N-doped TiO_2 Nanoparticles with Nitrogen Source from Shrimp Shell Waste Chitosan for Hydrogen Photoproduction

By:
Nurhasni (NIM: 2110412003)
Dr. Diana Vanda Wellia, M.Si*, Prof. Dr. Zilfa, M.S*
***Supervisors**

Global problems related to the use of fossil energy pose a major challenge to various sectors, especially the environment and economy. Therefore, it is necessary to transition towards the utilization of sustainable alternative energy sources such as hydrogen (H_2). This research aims to explore hydrogen production through photocatalytic method by utilizing nitrogen-doped TiO_2 catalyst under visible light. N-doped TiO_2 nanoparticles were synthesized through a solvothermal method, utilizing chitosan derived from shrimp shell waste as a nitrogen source in the doping process. Variations in the addition of chitosan concentration as a nitrogen dopant are 10% w/w (NTi10), 20% w/w (NTi20), 35% w/w (NTi35), and 50% w/w (NTi50). TiO_2 samples that were not doped with nitrogen (TO) were used as controls. Analysis of chitosan using FTIR showed a shift in the absorption peak of 3429 cm^{-1} towards a lower wave number, and a reduced absorption of amide I (C=O stretching vibration) at 1621 cm^{-1}. This confirmed the successful extraction of chitosan from shrimp shell waste. The effect of nitrogen doping on TiO_2 was observed by several characterizations. The synthesized N-doped TiO_2 nanoparticles were in the anatase phase as confirmed by XRD and Raman spectroscopy results. Based on the Diffuse Reflectance Spectroscopy UV-Vis (DRS UV-Vis) results using the Tauc-Plot method, it was found that all N-doped TiO_2 samples showed absorption in the visible light spectrum (λ = 400 - 800 nm) and a decrease in the energy gap compared to un-doped TiO_2 samples. The incorporation of nitrogen into the TiO_2 matrix was validated by the presence of vibrational bands in all samples around 535 cm-1 and 1053 cm-1 for NTi50, corresponding to Ti-O-Ti and Ti-N bonds as observed in FTIR analysis, respectively. FESEM-EDX results showed the surface morphology of NTi50 to be spheric with a dominant particle size of 14-16 nm and the presence of nitrogen (N) in the NTi50 variation. Photocatalytic activity testing revealed that the NTi20 sample achieved the highest efficiency and hydrogen production, which was 14 times greater than TO. Thus, it can be concluded that the synthesis of nitrogen-doped TiO_2 sourced from shrimp shell waste chitosan through a photocatalytic process has good potential for application in hydrogen (H_2) production as a sustainable clean energy.

Keywords: Shrimp Shell, N-doped TiO_2, Chitosan, Photocatalytic, Hydrogen Production