

INTISARI

SINTESIS NANOKOMPOSIT $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ UNTUK DEGRADASI LIMBAH METHYLENE BLUE (MB) DAN PENGHILANGAN LOGAM CHROMIUM (Cr (VI))

Oleh

Siska Irma Budianti

21/485444/PPA/06212

Nanopartikel $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ berhasil disintesis menggunakan metode kopresipitasi dan stober dengan berbagai konsentrasi (1:1, 1:2, 1:3, 1:4, dan 1:5). Hasil *X-ray diffractometer* (XRD) menunjukkan ukuran kristal pada $\text{NiZnFe}_2\text{O}_4$ sebelum dan setelah dimodifikasi menggunakan TiO_2 pada rentang nilai sebesar $(3,3 \pm 0,2) - (5,9 \pm 0,4)$ nm. Citra *transmission electron microscopy* (TEM) $\text{NiZnFe}_2\text{O}_4$ menunjukkan membentuk kelompok dan tidak terdispersi secara merata dalam kondisi teraglomerasi, dengan ukuran partikel rata-rata sebesar $(10,6 \pm 2,8)$ nm. *Selected area electron diffraction* menunjukkan bahwa $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ membentuk polikristalin. Hasil *scanning electron microscopy-energy dispersive X-Ray* menunjukkan keberadaan atom Ni, Zn, Fe, O dan Ti. Analisa *Fourier transform Infrared* (FTIR) menampilkan gugus-gugus fungsi O-H, C-H, dan H-O-H yang menunjukkan keberhasilan sintesis. Selain itu, adanya gugus fungsi $\text{MO}_{\text{octahedral}}$, $\text{MO}_{\text{tetrahedral}}$ dan Ti-O menunjukkan bahwa nanopartikel $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ telah terbentuk. Hasil pengujian sifat magnetik menggunakan *vibrating sample magnetometer* (VSM) menunjukkan bahwa nanopartikel memiliki nilai magnetisasi saturasi (M_s) pada rentang 12,4-22,9 emu/gr dan nilai koersivitas (H_c) pada rentang 47-55 Oe dan tidak mengalami saturasi. Spektrum absorbansi nanopartikel ini bergeser ke kanan (*redshift*) sehingga dapat menyerap sinar ultraviolet (UV). Nanopartikel ini memiliki energi celah pita dengan rentang nilai dari $(2,85 \pm 0,02) - (3,29 \pm 0,02)$ eV. Nanopartikel $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ dengan konsentrasi 1:2 memiliki efisiensi degradasi MB sangat baik dan mampu mencapai nilai degradasi 99,9%. $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ mampu didaur ulang hingga lima kali tanpa kehilangan aktivitas yang signifikan. Efisiensi penghilangan pada adsorpsi logam Cr(VI) mencapai 65,6%. Nanopartikel $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ dapat diaplikasikan sebagai material fotokatalis dan adsorpsi karena memiliki stabilitas dan reusabilitas yang baik.

Kata Kunci: Adsorpsi, fotokatalitik, nanopartikel, $\text{NiZnFe}_2\text{O}_4$, TiO_2 .

ABSTRACT

SYNTHESIS OF $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ NANOCOMPOSITES FOR DEGRADATION OF METHYLENE BLUE (MB) WASTE AND REMOVAL CHROMIUM (Cr (VI)) METAL

by

Siska Irma Budianti

21/485444/PPA/06212

$\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ nanoparticles were successfully synthesized using coprecipitation and stober methods with various concentrations (1:1, 1:2, 1:3, 1:4, and 1:5). X-ray diffractometer (XRD) results show the crystal size of $\text{NiZnFe}_2\text{O}_4$ before and after being encapsulated using TiO_2 in the range of values of $(3.3 \pm 0.2) - (5.9 \pm 0.4)$ nm. Transmission electron microscopy (TEM) image of $\text{NiZnFe}_2\text{O}_4$ shows that it forms clusters and is not evenly dispersed under agglomerated conditions, with an average particle size of (10.6 ± 0.8) nm. Selected area of electron diffraction shows that $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ forms polycrystalline. The results of scanning electron microscopy-energy dispersive X-Ray showed the presence of Ni, Zn, Fe, O and Ti atoms. Fourier transform Infrared (FTIR) analysis showed functional groups O-H, C-H, and H-O-H which indicated successful synthesis. In addition, the presence of $\text{MO}_{\text{octahedral}}$, $\text{MO}_{\text{tetrahedral}}$ and Ti-O functional groups indicated that $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ nanoparticles had been formed. The results of the magnetic properties test using a vibrating sample magnetometer (VSM) showed that the nanoparticles had a saturation magnetization value (M_s) in the range 12.4-22.9 emu/gr and a coercivity value (H_c) in the range 47-55 Oe and did not experience saturation. The absorbance spectrum of these nanoparticles is shifted to the right (redshift) so that they can absorb ultraviolet (UV) rays. These nanoparticles have a band gap energy with values ranging from $(2.85 \pm 0.02) - (3.29 \pm 0.02)$ eV. $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ nanoparticles with a concentration of 1:2 have very good MB degradation efficiency and are able to reach a degradation value of 99.9%. $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ can be recycled up to five times without significant loss of activity. The removal efficiency of Cr(VI) metal adsorption reached 65.6%. $\text{NiZnFe}_2\text{O}_4/\text{TiO}_2$ nanoparticles can be applied as photocatalyst and adsorption materials because they have good stability and reusability

Keywords: Adsorption, photocatalyst, nanoparticles, $\text{NiZnFe}_2\text{O}_4$, TiO_2 .