# STUDI PENGARUH KONSENTRASI $Ni^{2+}$ TERHADAP ENERGI CELAH PITA NANOKOMPOSIT $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$

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## INTISARI

Sintesis nanokomposit $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ telah dilakukan. Penelitian ini bertujuan untuk mendapatkan nanokomposit $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ dan mempelajari pengaruh konsentrasi Ni(II) pada nilai energi celah pita fotokatalis nanokomposit $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ pada daerah visibel.

Sintesis magnetit ($Fe_3O_4$) secara sonokopresipitasi. Pelapisan $SiO_2$ dan Ni-$TiO_2$ dilakukan dengan metode sol-gel. Sintesis $Fe_3O_4$ dilakukan dua perlakuan, $Fe_3O_4$ yang telah direndam *capping agent* natrium sitrat dicuci dengan akuabides hingga pH netral ($Fe_3O_4$ tercuci) dan tanpa dicuci dengan akuabides ($Fe_3O_4$ tidak tercuci). Variasi konsentrasi dopan $Ni^{2+}$ pada Ni-$TiO_2$ yaitu 3, 5 dan 7% (b/b). Hasil sintesis dikarakterisasi dengan spektrofotometri inframerah, *X-Ray Diffraction* (X-RD), *Transmission Electron Microscopy* (TEM), *Scanning Electron Microscopy-Energy Dispersive X-ray* (SEM-EDX) dan *Specular Reflectance Ultra Violet-Visible* (SRUV-Vis) *Spectrophotometry.*

Hasil penelitian menunjukkan $Fe_3O_4$ tidak tercuci mengalami aglomerasi dengan ukuran partikel $Fe_3O_4$ lebih besar dibanding $Fe_3O_4$ tercuci. Sintesis komposit $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ telah berhasil dilakukan menggunakan $Fe_3O_4$ tercuci. Keberadaan $Fe_3O_4$, $SiO_2$ dan Ni-$TiO_2$ terdeteksi pada spektra IR pada bilangan gelombang berturut – turut 578-586, 794 dan 1087, serta 478-800 $cm^{-1}$. Fase $Fe_3O_4$ ditunjukkan dengan puncak difraksi pada $2\theta$ 30,19; 35,47; 42,99; 53,29; 62,48; 69,06 dan 75,89˚. Keberadaan Ni-$TiO_2$ dibuktikan dengan puncak difraksi pada $2\theta$ 24,47 dan 44,01˚. Penambahan variasi konsentrasi dopan Ni pada $TiO_2$ mempengaruhi nilai energi celah pita nanokomposit $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$. Nilai energi celah pita $Fe_3O_4/SiO_2/Ni\text{-}TiO_2(3)$, $Fe_3O_4/SiO_2/Ni\text{-}TiO_2(5)$ dan $Fe_3O_4/SiO_2/Ni\text{-}TiO_2(7)$ masing – masing 3,07; 2,99 dan 3,05 eV. Energi celah pita yang lebih sesuai dengan daerah sinar tampak yaitu nanokomposit $Fe_3O_4/SiO_2/Ni\text{-}TiO_2(5)$.

Kata kunci: fotokatalis, magnetit, Ni-$TiO_2$

# *STUDY ON THE EFFECT OF $Ni^{2+}$ CONCENTRATION ON THE BAND GAP ENERGY OF $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ NANOCOMPOSITE*

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## ABSTRACT

Synthesis of $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ nanocomposite has been carried out. This research aimed to produce $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ nanocomposite and study the effect of Ni(II) concentration on $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ nanocomposite photocatalyst band gap energy values. The synthesis of $Fe_3O_4$ was performed by sono-coprecipitation, coating of $SiO_2$ and $Ni\text{-}TiO_2$ by sol-gel method. Synthesis $Fe_3O_4$ was carried out in 2 ways, $Fe_3O_4$ soaked with capping agent sodium citrate was washed by double distilled water until neutral and without washing. The concentration of $Ni^{2+}$ in Ni doped $TiO_2$ were 3, 5 and 7% (b/b). The characterization was performed by infrared spectrophotometry, X-Ray Diffraction (X-RD), Transmission Electron Microscopy (TEM), Scanning Electron Microscopy-Energy Dispersive X-ray (SEM-EDX) and Specular Reflectance Ultra Violet-Visible (SR UV-Vis) Spectrophotometry.

The results showed that unwashed $Fe_3O_4$ formed agglomeration with the size of $Fe_3O_4$ particles larger than washed $Fe_3O_4$. Synthesis of $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ nanocomposite has been successfully carried out with washing $Fe_3O_4$. The existence of $Fe_3O_4$, $SiO_2$ and $Ni\text{-}TiO_2$ was seen in the presence of absorption bands at 578-586, 794 and 1087, and 478-800 $cm^{-1}$. $Fe_3O_4$ phase was indicated by diffraction peaks at 2θ 30.19; 35.47; 42.99; 53.29; 62.48; 69.06 and 75.89˚ respectively. The existence of $Ni\text{-}TiO_2$ was seen by diffraction peaks at 2θ 24.47 and 44.01˚. The addition of Ni variations concentration in Ni doped $TiO_2$ influences the $Fe_3O_4/SiO_2/Ni\text{-}TiO_2$ nanocomposite band gap energy value. The band gap energy values of $Fe_3O_4/SiO_2/Ni\text{-}TiO_2(3)$, $Fe_3O_4/SiO_2/Ni\text{-}TiO_2(5)$ and $Fe_3O_4/SiO_2/Ni\text{-}TiO_2(7)$ are 3.07; 2.99 and 3.05 eV. Band gap energy that is more in line with visible light region was $Fe_3O_4/SiO_2/Ni\text{-}TiO_2(5)$ nanocomposite.

Keywords: photocatalyst, magnetite, Ni *doped* $TiO_2$