

## DEGRADASI FENOL DENGAN METODE FOTOKATALISIS MENGUNAKAN KOMPOSIT Co-N-CODOPED ZrTiO<sub>4</sub> DI BAWAH IRADIASI SINAR TAMPAK

Ika Nelly Astuti  
20/459306/PA/19967

### INTISARI

Fotokatalis zirkonium titanat ter-*doping* kobalt-nitrogen (Co-N-codoped ZrTiO<sub>4</sub>) telah digunakan dalam proses fotodegradasi senyawa fenol di bawah iradiasi sinar tampak. Penelitian ini bertujuan untuk mempelajari pengaruh konsentrasi dopan Co dan temperatur kalsinasi pada karakteristik Co-N-codoped ZrTiO<sub>4</sub> serta mempelajari aktivitas fotokatalisisnya dalam mendegradasi larutan fenol di bawah iradiasi sinar tampak. Metode yang digunakan adalah metode sol-gel. Sintesis diawali dengan pelarutan TTIP dalam etanol absolut kemudian direaksikan dengan suspensi zirkonia yang mengandung 10% N dan Co dengan variasi konsentrasi 0, 1, 3, 5, 7, dan 9%. Tahap kalsinasi divariasikan pada temperatur 500, 700, dan 900 °C selama 4 jam. Hasil sintesis dikarakterisasi menggunakan FTIR, XRD, SEM-EDX, dan SRUV. Proses fotodegradasi dilakukan dengan pencampuran Co-N-codoped ZrTiO<sub>4</sub> ke dalam larutan fenol 10 mg/L. Lama penyinaran divariasikan pada 15, 30, 45, 60, 75, 90, 105, dan 120 menit di bawah sinar tampak dengan pengadukan terus menerus. Konsentrasi fenol ditentukan dari pengukuran absorbansi pada panjang gelombang 269 nm dengan spektrofotometer UV-Vis.

Hasil yang diperoleh menunjukkan bahwa sintesis Co-N-codoped ZrTiO<sub>4</sub> dengan metode sol-gel berhasil dilakukan. Spektra FTIR dari komposit mengindikasikan adanya *overlapping* antara vibrasi Zr-O dan Ti-O-Ti pada bilangan gelombang 400-700 cm<sup>-1</sup>. Karakterisasi XRD menunjukkan bahwa fotokatalis memiliki fase monoklinik dan anatas pada temperatur 500 °C serta terbentuk fase rutil pada temperatur 700 dan 900 °C. Citra SEM menampilkan morfologi permukaan material Co-N-codoped ZrTiO<sub>4</sub> yang berbentuk bulat dan homogen. Analisis EDX dan *mapping* membuktikan adanya unsur utama Zr, Ti, O, N dan Co yang persebarannya merata pada material yang disintesis. Berdasarkan hasil analisis SRUV diketahui bahwa penambahan dopan Co dan N mampu menggeser tepi serapan fotokatalis ke daerah sinar tampak dengan energi celah pita sebesar 2,57 eV dan panjang gelombang 482 nm. Fotokatalis 5% Co-N-codoped ZrTiO<sub>4</sub> pada temperatur 500 °C mampu mendegradasi fenol sebesar 56,23% di bawah iradiasi sinar tampak dengan konstanta laju reaksi sebesar 0,0065 menit<sup>-1</sup> pada waktu iradiasi 120 menit.

Kata kunci: Co-N-codoped ZrTiO<sub>4</sub>, fenol, fotodegradasi, sinar tampak, sol-gel.

## **DEGRADATION OF PHENOL BY PHOTOCATALYSIS METHOD USING Co-N-CODOPED ZrTiO<sub>4</sub> COMPOSITE UNDER VISIBLE LIGHT IRRADIATION**

Ika Nelly Astuti  
20/459306/PA/19967

### **ABSTRACT**

Cobalt-nitrogen codoped zirconium titanate photocatalyst (Co-N-codoped ZrTiO<sub>4</sub>) has been used in the photodegradation process of phenol compounds under visible light irradiation. This research aims to study the effect of Co dopant concentration and calcination temperature on the characteristics of Co-N-codoped ZrTiO<sub>4</sub> and to study its photocatalytic activity in degrading phenol solution under visible light irradiation. The method used was sol-gel method starting with the dissolving of TTIP in absolute ethanol and then reacted with zirconia suspension containing 10% N and Co with varying concentrations of 0, 1, 3, 5, 7, and 9%. The calcination stage was varied at 500, 700, and 900 °C for 4 hours. The synthesis results were characterized using FTIR, XRD, SEM-EDX, and SRUV. The photodegradation process was carried out by mixing Co-N-codoped ZrTiO<sub>4</sub> with various Co concentrations into a 10 mg/L phenol solution. The irradiation time was varied at 15, 30, 45, 60, 75, 90, 105, and 120 minutes under visible light with continuous stirring. The concentration of phenol was determined from absorbance measurements at a wavelength of 269 nm with a UV-Vis spectrophotometer.

The results obtained showed that Co-N-codoped ZrTiO<sub>4</sub> was introduced by the sol-gel method. FTIR spectra of composite exhibited overlapping vibration of Zr-O and Ti-O-Ti in the wave numbers range 400-700 cm<sup>-1</sup>. XRD characterization shows that the photocatalyst has monoclinic and anatase phase at 500 °C and rutile phase is formed at 700 and 900 °C. SEM images display the surface morphology of the Co-N-codoped ZrTiO<sub>4</sub> material which is round and homogeneous. EDX analysis and mapping proved the presence of the main elements Zr, Ti, O, N and Co which are evenly distributed in the synthesized material. Based on the results of SRUV analysis, it is known that the addition of Co and N dopants can shift the absorption edge of the photocatalyst to the visible light region with a band gap energy of 2.57 eV and a wavelength of 482 nm. The 5% Co-N-codoped ZrTiO<sub>4</sub> photocatalyst at 500 °C was able to degrade phenol by 56.23% under visible light irradiation with a reaction rate constant of 0.0065 min<sup>-1</sup> at 120 min irradiation time.

**Keywords:** Co-N-codoped ZrTiO<sub>4</sub>, phenol, photodegradation, sol-gel, visible light.