SINTESIS Fe,N-*CODOPED* $ZrTiO_4$ SEBAGAI MODEL FOTOKATALIS RESPONSIF TERHADAP SINAR TAMPAK DENGAN VARIASI KONSENTRASI DOPAN DAN SUHU KALSINASI

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INTISARI

Penelitian tentang sintesis Fe,N-*codoped* $ZrTiO_4$ sebagai model fotokatalis responsif terhadap sinar tampak telah dilakukan. Pengaruh konsentrasi dopan besi dan suhu kalsinasi terhadap karakter kristal dan aktivitas fotokatalitik material Fe,N *codoped* $ZrTiO_4$ juga dipelajari pada penelitian ini. Material disiapkan dengan membuat prekursor Ti dengan mencampurkan Titanium (IV) isopropoksida (TTIP) dan etanol absolut, kemudian direaksikan dengan suspensi yang mengandung ZrO_2, urea 10% dan garam $FeSO_4.7H_2O$ dengan variasi persentase 0, 1, 3, 5, 7 dan 9% (b/b). Seluruh material Fe,N-*codoped* $ZrTiO_4$ dikalsinasi pada suhu 500 °C selama 4 jam. Pengaruh suhu kalsinasi dipelajari dengan material 5% Fe,N *codoped* $ZrTiO_4$ yang dikalsinasi pada berbagai suhu kalsinasi yaitu 500, 700 dan 900 °C. Seluruh material dikarakterisasi dengan XRD, FT-IR, SEM-EDX dan SR-UV.

Dari hasil karakterisasi XRD, diketahui bahwa dopan Fe dan N dapat menghambat pertumbuhan kristal TiO_2 sehingga menghasilkan pembentukan kristal *anatase* yang lebih kecil. ZrO_2 mampu mencegah transformasi *anatase* menjadi rutil. Spektra FT-IR menunjukkan adanya perubahan struktur kristal yang ditandai adanya penurunan intensitas serapan Ti-O-Ti pada 400-700 cm^{-1} seiring kenaikan konsentrasi dopan dan munculnya pita vibrasi pada 1080 cm^{-1} yang merupakan ikatan Ti-O-Fe atau O-Ti-N. Spektrum serapan UV-Vis teramati pergeseran merah dari $ZrTiO_4$ ter-*codoping* Fe dan N. Nilai energi celah pita terendah diperoleh pada konsentrasi 3% Fe dan 10% N yang dikalsinasi pada suhu 500 °C dengan nilai Eg sebesar 2,62 eV. Analisis SEM menunjukkan bahwa morfologi Fe,N-*codoped* $ZrTiO_4$ berbentuk bulat dan seragam, dengan permukaan yang lebih kasar dibandingkan ZrO_2 murni. Hasil spektrum EDX membuktikan adanya unsur utama Zr, O, Ti, Fe dan N pada material yang disintesis.

Kata kunci: besi, Fe,N-*codoped* $ZrTiO_4$, fotokatalis, nitrogen, sol-gel

SYNTHESIS OF Fe,N-CODOPED $ZrTiO_4$ AS A MODEL OF VISIBLE LIGHT RESPONSIVE PHOTOCATALYST WITH VARIOUS DOPANT CONCENTRATIONS AND CALCINATION TEMPERATURES

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ABSTRACT

Research on the synthesis of Fe,N-codoped $ZrTiO_4$ material as a photocatalyst model responsive to visible light has been conducted. The influences of iron dopant concentration and calcination temperature on the crystal character and photocatalytic activity of Fe,N-codoped ZrTiO4 were also studied. The materials were prepared by creating a Ti precursor by mixing Titanium (IV) isopropoxide (TTIP) and absolute ethanol, then reacted with a suspension containing ZrO_2, 10% urea, and $FeSO_4.7H_2O$ salt with various concentrations of 0, 1, 3, 5, 7 and 9% (w/w). All Fe,N-codoped $ZrTiO_4$ materials were calcined at 500 °C for 4 hours. The effect of calcination temperature was studied using 5% Fe,N-codoped $ZrTiO_4$ which was calcined in various calcination temperatures at 500, 700 and 900 °C. All materials were characterized by XRD, FT-IR, SEM-EDX, and SR-UV.

From XRD characterization, it is known that Fe and N dopants can inhibit the growth of TiO_2 crystals, resulting in the formation of smaller anatase crystals. ZrO_2 was able to prevent the transformation of anatase to rutile. The FT-IR spectrum indicated a change in crystal structure with a decrease in the intensity of Ti-O-Ti absorption at 400-700 cm^{-1} along with an increase in dopant concentration and the presence of a vibrational band at 1080 cm^{-1} that was suggested to be Ti-O-Fe or O-Ti-N bond. The UV-Vis absorption spectra observed a red shift of the $ZrTiO_4$ codoped with Fe and N photocatalysts. The lowest band gap was found at concentrations of 3% Fe and 10% N which was calcined at 500 °C with a bandgap value of 2.62 eV. SEM analysis revealed the morphology of Fe,N-codoped $ZrTiO_4$ is spherical and uniform, with a rougher surface than pure ZrO_2. The results of the EDX spectrum proved the presence of the main elements Zr, O, Ti, Fe, and N in the synthesized material.

Keywords: Fe,N-codoped $ZrTiO_4$, iron, nitrogen, photocatalyst, sol-gel