Green Synthesis Nanokomposit ZnO/CeMnO3 menggunakan Ekstrak Daun Bayam Raja (Amaranthus viridis) dan Uji Aktivitas Fotokatalitiknya terhadap Degradasi Malasit Hijau = Green Synthesis ZnO/CeMnO3 Nanocomposite using Green Amaranth (Amaranthus viridis) Leaf Extract and The Photocatalytic Activity Test on Malachite Green Degradation

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Abstrak

Pada penelitian ini, sintesis nanokomposit ZnO/CeMnO₃ dilakukan dengan metode green synthesis menggunakan ekstrak daun bayam raja (Amaranthus viridis). Metabolit sekunder pada ekstrak digunakan sebagai basa lemah dan capping agent dalam proses sintesis nanokomposit. Untuk mengidentifikasi sifat optik dan struktural nanopartikel serta nanokomposit, dilakukan dikarakterisasi dengan instrumen UV-Vis DRS, FTIR, XRD, Photoluminescence, SEM-EDX, dan HRTEM. Nanokomposit ZnO/CeMnO₃ menunjukkan nilai band gap yang menurun dibanding ZnO, yaitu pada 2,68 eV. Selain itu, karakterisasi HRTEM mengkonfirmasi terbentuknya ZnO/CeMnO₃ heterojunction dengan d spacing ZnO (110) = 0,162 nm dan d spacing CeMnO₃ = 0,31 nm. Ukuran partikel rata-rata ZnO/CeMnO₃ adalah 7,46 nm. Aktivitas fotokatalitik nanokomposit ZnO/CeMnO₃ diuji untuk mendegradasi larutan malasit hijau di bawah sinar tampak selama 120 menit serta dibandingkan dengan aktivitas fotokatalitik nanopartikel ZnO dan CeMnO₃. Persentase fotodegradasi malasit hijau oleh ZnO/CeMnO₃, CeMnO₃, dan ZnO masing-masing bernilai 92,69%; 69,46%; dan 37,5%. Kinetika reaksi fotodegradasi nanokomposit ZnO/CeMnO₃ mengikuti model orde satu semu dengan konstanta laju senilai 1,031 x 10⁻²min⁻¹. Peningkatan aktivitas fotokatalitik nanokomposit ZnO/CeMnO₃ disebabkan karena adanya penurunan bandgap ZnO dan rendahnya laju fotorekombinasi electron-hole yang masing-masing dibuktikan oleh analisis spektroskopi UV-Vis DRS dan photoluminescence.

.....In this study, ZnO/CeMnO₃ nanocomposites were synthesized using green synthesis method using green amaranth leaf extract (Amaranthus viridis). The secondary metabolites present in the extract were utilized as a weak base and capping agent during the synthesis processes. To identify the optical and structural properties of the synthesized nanoparticles and nanocomposites, characterization was performed using UV-DRS, FTIR, XRD, Photoluminescence, SEM-EDX, and HRTEM instruments. The synthesized ZnO/CeMnO₃ nanocomposite showed a decreased band gap value compared to ZnO, at 2,68 eV. Additionally, XRD and HRTEM characterization confirmed the formation of the ZnO/CeMnO₃ composite on a nanometer scale with the average particle size at 7,46 nm. The photocatalytic activity of the ZnO/CeMnO₃ nanocomposite was tested by degrading a malachite green solution under visible light for 120 minutes and compared with the photocatalytic activity of ZnO and CeMnO3 nanoparticles. The percentages of malachite green photodegradation by ZnO/CeMnO₃, CeMnO₃, and ZnO were 92,69%; 69,46%;

and 37,5%, respectively. The photodegradation reaction kinetics of the ZnO/CeMnO₃ nanocomposite were also determined to follow a pseudo-first-order model with a rate constant of 1.031 x 10⁻² min⁻¹. The increase in photocatalytic activity of the ZnO/CeMnO₃ nanocomposite is due to a decrease in the bandgap and a low rate of electron-hole photorecombination which is proven by UV-Vis DRS and photoluminescence analysis respectively.