Pengaruh penambahan unsur logam transisi (Mn, Co, Ni, dan Cu) terhadap struktur, sifat optik, dan sifat magnetik nanopartikel Fe - doped ZnO = The Effect of adding transition metal element (Mn, Co, Ni, and Cu) on the structure, optical, and magnetic properties of Fe - doped ZnO nanoparticles

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Abstrak

Upaya kodoping ZnO dengan dua jenis unsur logam transisi yang berbeda diyakini mampu meningkatkan kualitas sifat room temperature ferromagnetic (RTFM) dari diluted magnetic semiconductor (DMS) ZnO yang didoping menggunakan satu jenis logam transisi saja. Oleh sebab itu pada penelitian ini, dilakukan studi mengenai efek penambahan unsur Mangan (Mn), Kobalt (Co), Nikel (Ni) dan Tembaga (Cu) pada nanopartikel Fe - doped ZnO terhadap perubahan struktur, sifat optik dan sifat magnetiknya.
Pembuatan sampel dilakukan dengan metode ko-presipitasi pada temperatur ruangan. Analisis struktur sampel dilakukan menggunakan pengukuran Energy Dispersive X-ray (EDX), X-ray diffraction (XRD), dan Fourier Transform Infrared (FT-IR), sedangkan studi mengenai sifat optiknya dilakukan berdasarkan hasil spektroskopi Uv-vis. Adapun sifat magnetik dari sampel dipelajari melalui pengukuran Electron Spin Resonance (ESR) dan Vibrating Sample Magnetometer (VSM).
Pola difraksi XRD menunjukkan bahwa keempat sampel masih memiliki struktur hexagonal wurtzite ZnO dalam batas sensitivitas alat ukur. Hasil pengukuran Uv-vis menunjukkan adanya penurunan nilai celah energi akibat pembentukan mid-gap. Sementara itu, hasil pengukuran ESR menunjukkan adanya pengaruh ion-ion dopan sekunder (Mn, Co, Ni, dan Cu) dalam menentukan sifat magnetik sampel. Dan hasil pengukuran VSM menunjukkan adanya penguatan sifat RTFM yang signifikan.
.....The attempt of codoping ZnO with two different kinds of transition metal elements is believed to be the key to enhance the room temperature ferromagnetism (RTFM) of single transition metal - doped ZnO diluted magnetic semiconductor (DMS). Therefore, within the scope of this research, the effects of adding Manganese (Mn), Cobalt (Co), Nickel (Ni), and Cooper (Cu) regarding to the structural, optical, and magnetic properties change of Fe - doped ZnO nanoparticles have been studied.
The synthesis of the samples was done by co-precipitation method at room temperature. The structural analysis had been performed by Energy Dispersive X- ray (EDX), X-ray Diffraction (XRD), and Fourier Transform Infrared (FT-IR) measurements, meanwhile the optical properties were studied based on the result of Uv-vis spectroscopy. The magnetic properties were studied through Electron Spin Resonance (ESR) and Vibrating Sample Magnetometer (VSM) measurements.
The diffraction pattern of XRD shows that all of the samples still possess hexagonal wurtzite ZnO structure within the sensitivity limit of the spectrometer. The Uv-vis measurement results indicate the decrease in band gap due to the forming of mid-gaps. Meanwhile, ESR measurement results reveal the influence of secondary dopant ions (Mn, Co, Ni, and Cu) that affects the magnetic behavior. Moreover, the VSM measurement result shows a significant enhancement of RTFM.