PENGARUH PELARUT PADA SIFAT OPTIK *CARBON DOTS* (CDs) YANG DISINTESIS DARI RUMPUT GAJAH (*Pennisetum purpureum*) DAN APLIKASINYA SEBAGAI TINTA ANTI-PEMALSUAN

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INTISARI

Carbon Dots (CDs) memiliki potensi yang besar sebagai tinta anti-pemalsuan karena sifat optiknya yang unik, sintesis yang sederhana, serta biaya produksi yang rendah dan ramah lingkungan. Upaya pemanfaatan limbah rumput gajah *(Pennisetum purpureum)* sebagai prekursor dalam sintesis CDs telah dilakukan melalui metode hidrotermal menggunakan pelarut akuabides yang diikuti pemurnian bertingkat. Tujuan dari penelitian ini adalah untuk mengetahui pengaruh pelarut terhadap sifat optik CDs yang dihasilkan. Karakterisasi sifat optik dilakukan dengan spektrofotometer UV-Vis dan spektrofluorometer, gugus fungsi dianalisis dengan *attenuated total reflectance-infrared* (ATR-IR), sementara morfologi dan ukuran diamati menggunakan *transmission electron microscope* (TEM). Selanjutnya, uang kertas yang ditandai dengan tinta CDs diamati pendarannya di bawah sinar UV.

Hasil penelitian menunjukkan bahwa sintesis CDs berhasil dilakukan dengan metode hidrotermal. *Carbon dots* hasil sintesis berbentuk sferis dengan struktur amorf berukuran rata-rata 3,45. *Oxygen containing functional group* (OCG) pada CDs mengakibatkan emisi fluoresensi berwarna biru terang di bawah sinar UV. Pemurnian bertingkat terbukti dapat meningkatkan *quantum yield* (QY) dari 8,74% menjadi 10,65%. Pengaruh pelarut pada sifat optik CDs menunjukkan fenomena unik, di mana spektra serapan UV-Vis tidak bergantung pada pelarut, tetapi fluoresensinya sangat dipengaruhi. Emisi CDs dipengaruhi karakteristik transisi n-π* dan menunjukkan pergeseran biru dalam pelarut air murni akibat interaksi ikatan hidrogen. Sementara itu, fenomena pelarutan preferensial menyebabkan pergeseran merah terjadi dalam sistem pelarut biner air/alkohol. Meskipun memiliki sifat fluoresensi yang unik, aplikasi CDs sebagai tinta anti-pemalsuan pada uang kertas tidak dapat diamati secara signifikan. Hal ini disebabkan oleh QY yang relatif rendah dan fenomena peredaman fluoresensi akibat agregasi (*Aggregation-Induced Quenching*) yang terjadi karena perubahan lingkungan CDs pada permukaan uang kertas.

Kata kunci: *carbon dots*, fluoresensi, pelarut, tinta

THE INFLUENCE OF SOLVENT ON THE OPTICAL PROPERTIES OF CARBON DOTS SYNTHESIZED FROM ELEPHANT GRASS (*Pennisetum purpureum*) AND ITS APPLICATION AS ANTI-COUNTERFEITING INK

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ABSTRACT

Carbon Dots (CDs) possess unique optical properties, simple synthesis routes, and low-cost, eco-friendly production, making them promising candidates for anti-counterfeiting ink applications. Efforts to utilize elephant grass (*Pennisetum purpureum*) as a precursor for CDs synthesis have been made through a hydrothermal method using aquabides as the solvent, followed by multistage purification post-treatment. The research aims to investigate the effect of solvents on the optical characteristics of the resulting CDs. Optical properties were characterized using UV-Visible spectrophotometry and spectrofluorometry, functional groups were identified via attenuated total reflectance infrared spectroscopy (ATR-IR), and morphological features were examined through transmission electron microscopy (TEM). The fluorescence emission of CDs-labeled banknotes was also examined under UV illumination.

The study demonstrated the successful synthesis of carbon dots (CDs) through a hydrothermal method. The synthesized carbon dots exhibited spherical morphology with an amorphous structure and an average particle diameter of 3.45 nm. The presence of oxygen-containing functional groups (OCGs) induced bright blue fluorescence emission under ultraviolet (UV) irradiation. A multistage purification process was shown to enhance the quantum yield (QY) from 8.74% to 10.65%. Solvent-dependent analysis of the CDs' optical properties revealed a distinct phenomenon in which UV-Vis absorption spectra remained consistent across solvents, while fluorescence emission was highly sensitive to solvent composition. Emission behavior was governed by n–π* electronic transitions, with a blue shift observed in pure water solvent due to hydrogen bonding interactions. Conversely, preferential solvation effects caused a red shift in the water/alcohol binary solvent system. Despite their distinctive fluorescence, the application of CDs as anti-counterfeiting ink for banknotes could not be significantly observed. This was primarily due to low QY and fluorescence quenching caused by aggregation phenomena (Aggregation-Induced Quenching) that occurred as a result of environmental changes at the CDs–substrate interface.

Keywords: carbon dots, fluorescence, ink, solvent