ABSTRAK

SINTESIS DAN KARAKTERISASI Zn-BCNO UNTUK APLIKASI ADSORPSI, FOTOKATALIS, DAN ANTIBAKTERI MENGGUNAKAN METODE *SOLID STATE*

Air sebagai sumber utama kehidupan menjadi terbatas keberadaannya akibat dari pencemaran limbah zat warna sintetis seperti metil hijau yang dihasilkan oleh keberadaan industri tekstil, serta dampak dari kepadatan penduduk yang berakhir pada dihasilkannya limbah rumah tangga sehingga mendukung pertumbuhan bakteri. Dalam mengatasi permasalahan ini, *Boron carbon oxynitride* (BCNO) digunakan sebagai material semikonduktor yang dapat diaplikasikan secara luas dalam berbagai bidang. Teknik *doping* dilakukan terhadap material BCNO untuk mengetahui pengaruh terhadap sifat fisik dan kimianya dalam meningkatkan aktivitas adsorpsi, fotokatalis, dan antibakteri. Dalam penelitian ini dilakukan sintesis BCNO dan BCNO terdoping Zn dengan menggunakan metode *solid-state.* Hasil sintesis dikarakterisasi menggunakan XRD, SEM, spektroskopi FTIR, PL, dan Spektrofotometer UV-Vis-NIR. Kinerja dari material ini diuji terhadap zat warna metil hijau melalui proses adsorpsi dan fotokatalis, serta aktivitas antibakterinya terhadap bakteri gram-positif (*Staphylococcus aureus*) dan gram-negatif *(Eschercia coli)* menggunakan metode cakram kertas. Berdasarkan hasil XRD nilai persen kristalinitas yang didapat untuk BCNO dan Zn-BCNO masing-masing sebesar 41,3% dan 41,7%. Ukuran kristal yang didapat masing-masing sebesar 0,68 nm dan 0,65 nm. Morfologi yang ditampilkan SEM pada BCNO dan Zn-BCNO masing-masing mengkonfirmasi bentuk permukaan batang dan tak beraturan. Hasil spektroskopi FTIR mengkonfirmasi adanya unsur boron, karbon, oksigen, dan nitrogen melalui gugus-gugus yang diamati. Pada analisis PL menunjukkan terbentuknya puncak emisi UV. Analisis UV-Vis-NIR juga mengkonfirmasi penurunan energi celah pita BCNO dan Zn-BCNO masing-masing sebesar 4,0154 eV dan 3,6455 eV. Pada pengujian kinerja aktivitas adsorpsi, didapatkan kondisi optimum dekolorisasi zat warna metil hijau oleh BCNO dan Zn-BCNO masing-masing sebesar 87,25% dan 92,78% pada waktu 120 menit dengan nilai kapasitas adsorpsi optimum selama 120 menit masing-masing sebesar 72,07 $mg.g^{-1}$ dan 153,75 $mg.g^{-1}$. Kinerja untuk aktivitas fotokatalis didapatkan kondisi optimum dekolorisasi zat warna metil hijau oleh BCNO dan Zn-BCNO masing-masing sebesar 88,45% dan 94,21% selama waktu iradiasi 120 menit. Sementara hasil pengujian aktivitas antibakteri menunjukkan hasil BCNO dan Zn-BCNO aktif digunakan dalam proses inhibisi bakteri dengan nilai zona inhibisi > 9 mm.

Kata-kata kunci: adsorpsi; BCNO; fotokatalis; *solid-state;* zona inhibisi.

ABSTRACT

SYNTHESIS AND CHARACTERIZATION OF Zn-BCNO FOR ADSORPSI, PHOTOCATALIST, AND ANTIBACTERY APPLICATIONS BY SOLID STATE METHODS

Water as the main source of life is limited due to pollution from synthetic dyes such as methyl green produced by the textile industry, as well as the impact of population density which results in the generation of household waste that supports the growth of bacteria. In overcoming this problem, Boron carbon oxynitride (BCNO) is used as a semiconductor material that can be widely applied in various fields. The doping technique is carried out on BCNO material to determine the effect on its physical and chemical properties in enhancing adsorption, photocatalyst, and antibacterial activities. In this study, BCNO and Zn-doped BCNO were synthesized using solid-state method. The synthesis results were characterized using XRD, SEM, FTIR spectroscopy, PL, and UV-Vis-NIR spectrophotometer. The performance of this material was tested against methyl green dye through adsorption and photocatalyst processes, as well as its antibacterial activity against gram-positive (Staphylococcus aureus) and gram-negative (Eschercia coli) bacteria using the paper disc method. Based on the XRD results, the percent crystallinity values obtained for BCNO and Zn-BCNO were 41.3% and 41.7%, respectively. The crystal size obtained was 0.68 nm and 0.65 nm, respectively. The morphology displayed by SEM on BCNO and Zn-BCNO confirmed the rod and irregular surface shapes, respectively. The FTIR spectroscopy results confirmed the presence of boron, carbon, oxygen, and nitrogen elements through the groups characterized by the presence of boron, carbon, oxygen, and nitrogen through the observed groups. PL analysis showed the formation of UV emission peaks. UV-Vis-NIR analysis also confirmed the decrease in band gap energy of BCNO and Zn-BCNO by 4.0154 eV and 3.6455 eV, respectively. In testing the performance of adsorption activity, the optimum conditions for decolorization of methyl green dye by BCNO and Zn-BCNO were obtained at 87.25% and 92.78%, respectively, at 120 minutes with optimum adsorption capacity values for 120 minutes of 72.07 mg.g-1 and 153.75 mg.g-1, respectively. Performance for photocatalyst activity obtained optimum conditions for decolorization of methyl green dye by BCNO and Zn-BCNO of 88.45% and 94.21% respectively during irradiation time of 120 minutes. While the results of antibacterial activity testing showed the results of BCNO and Zn-BCNO actively used in the process of bacterial inhibition with the value of the inhibition zone > 9 mm.

Keywords: adsorption; BCNO; inhibition zone; photocatalytic; solid-state.