Facile Synthesis and Characterization of Palm CNF-ZnO Nanocomposites with Antibacterial and Reinforcing Properties

Supplementary Information

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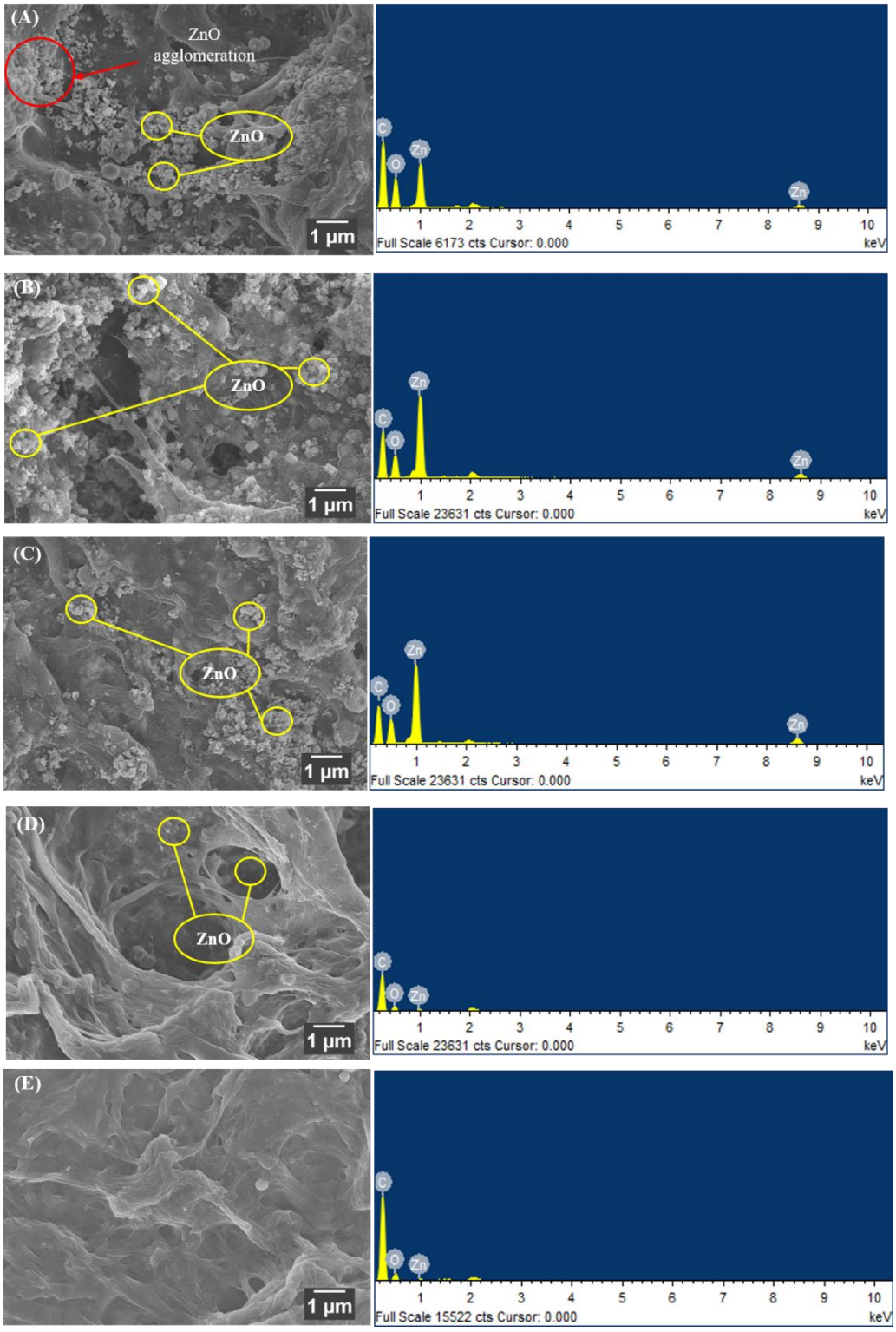

Figure S1: Morphology and EDX analysis of CNF-ZnO nanocomposite – (A) Control - pH 12.5, (B) pH 10, (C) pH 8, (D) pH 6, (E) pH 4.

The amount of zinc ions available used in this section was estimated using the equation below

$$Zn(C_2H_3O_2)_2.2H_2O \rightarrow Zn^{2+} + 2(C_2H_3O_2)^- + 2H_2O$$

The total zinc acetate dihydrate used in this experiment was 0.439 g dissolved in 200 ml of ultrapure water

The molecular weight of zinc acetate dihydrate was determined to be 219.498 g/mol

The molecular weight of elemental zinc = 65.37 g/mol

$$\frac{0.439\ \text{g}}{219.48\ \text{g/mol}} = \frac{0.439}{219.48}\ \text{mol} \rightarrow 0.002\ \text{mol}$$

$$\frac{0.439\ \text{g}}{200\ \text{ml x } 219.48\ \text{g/mol}} \times 1000\ \text{ml/l} = 0.01\ \text{mol/l}$$

$$\frac{0.01\ \text{mol/l} \times 65.37\text{g/mol}}{1.00\ \text{l}} = 0.6537\ \text{g/l} \rightarrow 653.7\ \text{mg/l}$$

Therefore, the estimated concentration of zinc ions used in this experiment was 653.7 mg/L. Using the ICP-OES method, the amount of zinc ion concentration on the CNF-ZnO nanocomposite was determined. Briefly, the ZnO-NP content in CNF before and after treatment was measured using ICP-OES (Perkin Elmer Optima 8000) with a 0.001 ppm metal ion detection limit. Initially the collected solution (filtrate) from the filter process of CNF-ZnO nanocomposite formation was used in this analysis. 1.00 ml of filtrate was diluted in 1000 ml of water and agitated via magnetic stirring at 500 rpm prior to the analysis. Approximately 10 ml of the diluted filtrate was transferred to a 50 ml plastic centrifuge tube and placed on a sample tray for the ICP-OES analysis. The Zn^{2+} content (Z) in CNF was determined from the following equation (1):

$$Z = C_{initial} - (C_{final} \times 1000) \quad \textbf{(1)}$$

where, $C_{initial}$ is the concentration of initial zinc used to form the nanocomposite and C_{final} is the filtrate concentration. After the ICP-OES analysis, the amount of Zn^{2+} ions identified in the effluent was 0.009 ppm. Based on equation (1), the estimated amount of zinc presences on the fabricated nanocomposite was calculated to be 644.7 mg/l.

Sample Calculation

$$Z = 653.7\ \text{mg/l} - (0.009\ \text{mg/l} \times 1000) = 644.7\ \text{mg/l} \rightarrow 644.7\ \text{ppm}$$

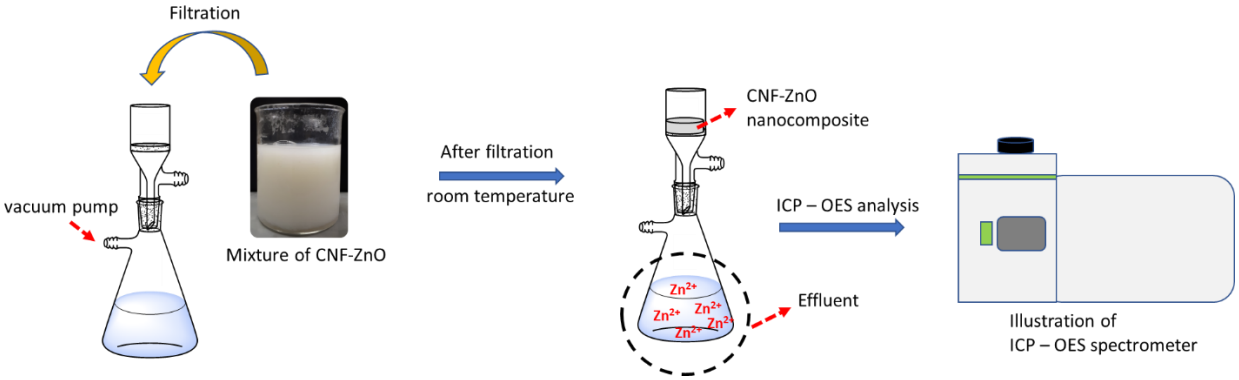

Figure S2: Method used to estimate the amount of Zn^{2+} presence in the synthesized CNF-ZnO nanocomposite.