Supplementary Information

[1]Md. Raihan Siddiki, [1]Shahid Abubakar Abtahee, [2] Mizanur Rahaman,

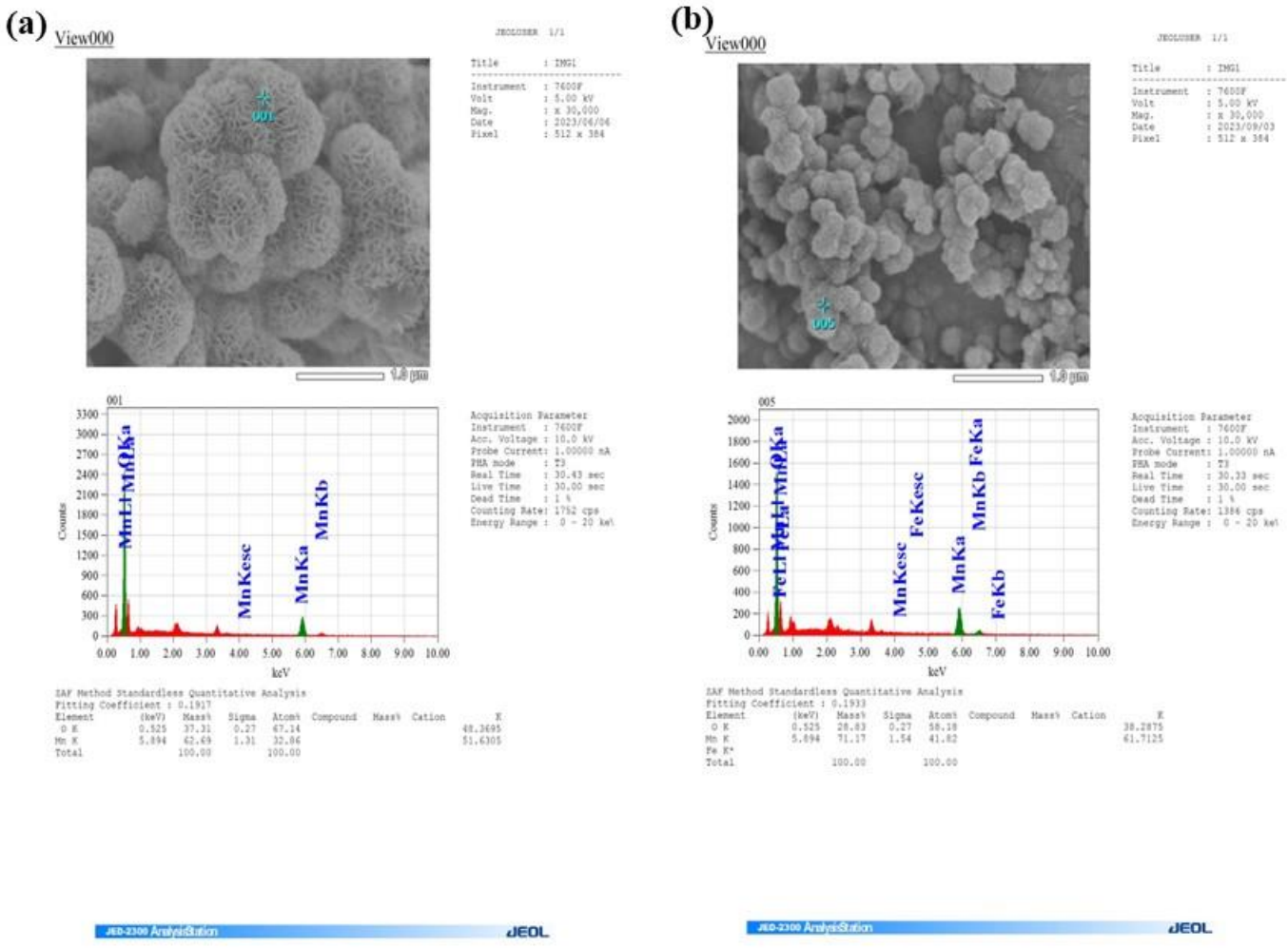
[2]Muhammad Rakibul Islam and [1*]Md. Abdullah Zubair

[1]Department of Nanomaterials and Ceramic Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka-1000, Bangladesh

[2]Department of Physics, Bangladesh University of Engineering and Technology (BUET), Dhaka-1000, Bangladesh

[*] Corresponding author email: mazubair2017@gmail.com (M. A. Zubair)

S1. Energy Dispersive X-ray Analysis (EDX)



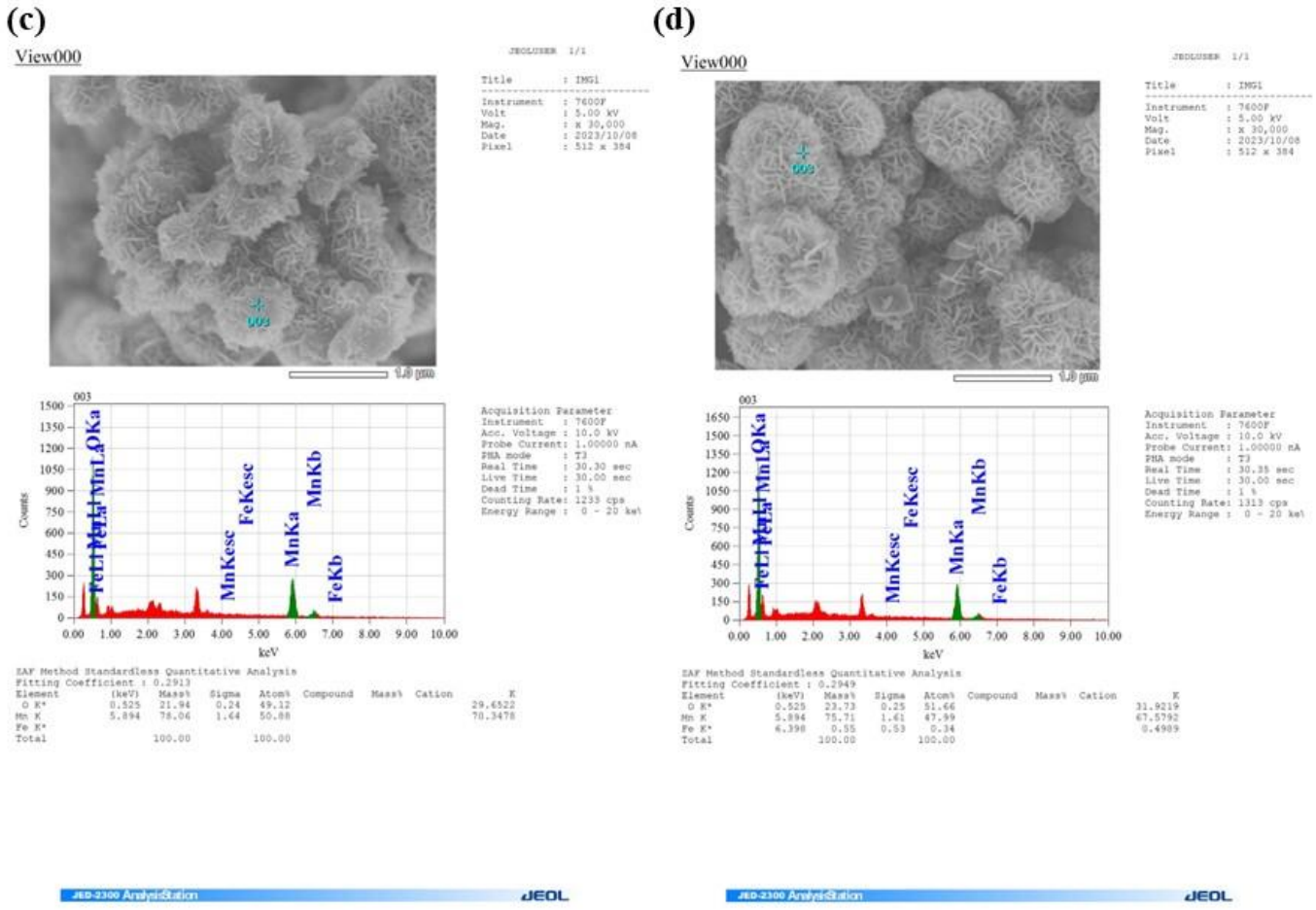


Figure SF1: Typical EDX spectra of (a) pure MnO_2 (b) MnO_2/ (1%) Fe_3O_4, (c) MnO_2/ (3%) Fe_3O_4, (d) MnO_2/ (5%) Fe_3O_4. Here the figures show only the typical spectra from the EDX point analysis for each sample, where each synthesized nanocomposite was subjected to at least 10 spectral analyses from randomly selected regions of the sample.

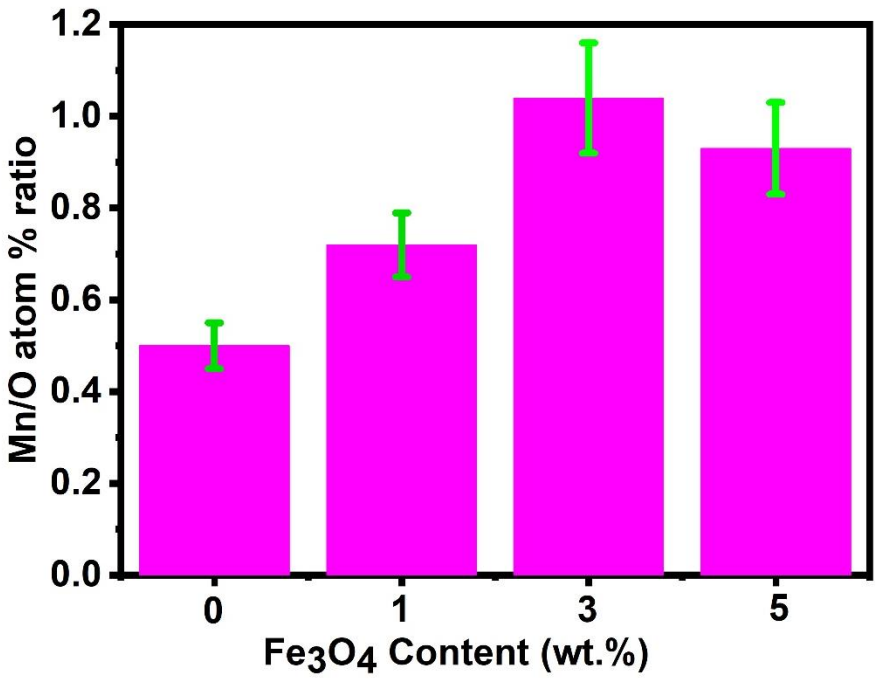


Figure SF2: Variation of Mn/O atom % ratio with the addition of Fe_3O_4 nanodiamonds in MnO_2 nanoflower. The atomic ratio of Mn/O is calculated following the semiquantitative Energy Dispersive X-ray (EDX) spectrum as shown in Figure SF1. The ratio is ~ 0.5 in pristine MnO_2, indicating the stoichiometric proportion of Mn and O in this compound. However, this ratio tends to rise with the addition of Fe_3O_4 with MnO_2/ (3%) Fe_3O_4 nanocomposite exhibiting the highest ratio of ~ 1.04 among all synthesized samples. This indicates that the density of lattice oxygen vacancy defects within the crystal structure increases with the incorporation of Fe_3O_4 nanodiamond in MnO_2.

S2. Cyclic Stability

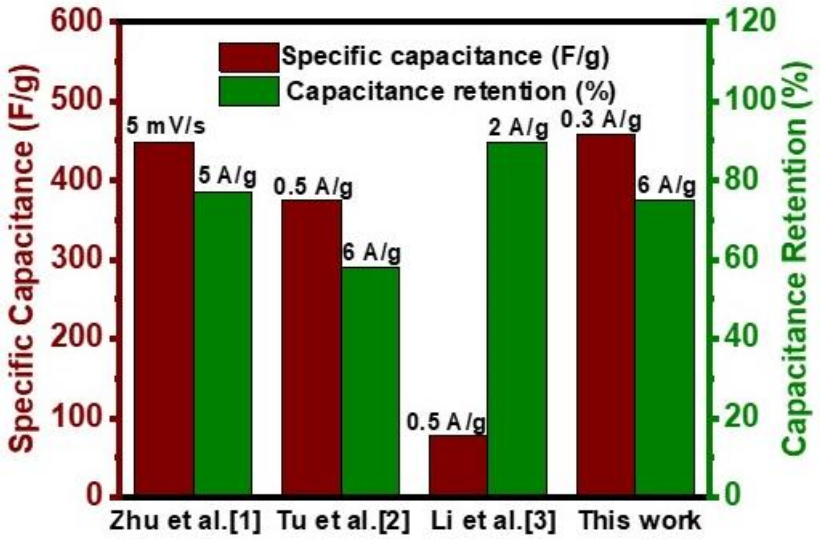


Figure SF3: Comparison between the previously reported MnO_2/Fe_3O_4 based works[1–3] *and this work. The δ-MnO_2 / (3%) Fe_3O_4 nanocomposite exhibited comparable specific capacitance and % of capacitance retention in cyclic stability performance. (Measurement conditions are provided above the bar, and all data reflect the cyclic stability over 4000 cycles)*

References:

1 J. Zhu, S. Tang, H. Xie, Y. Dai and X. Meng, *ACS Appl. Mater. Interfaces*, 2014, **6**, 17637–17646.

2 C. Tu, X. Li, C. Lu, Q. Luo, T. Li and M. Zhu, *Mater. Chem. Front.*, 2022, **6**, 1938–1947.

3 Z. Li, Y. Yao, Y. Zheng, T. Gao, Z. Liu and G. Zhou, *Journal of The Electrochemical Society*, 2018, **165**, E58.