The comparative analysis of the electromagnetic shielding efficiency of graphene oxide composites with different silver nanostructures

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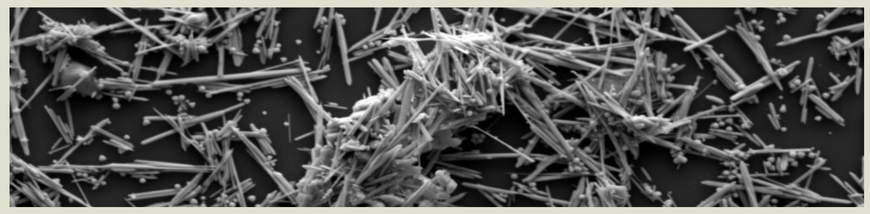

01 INTRODUCTION

The electronic devices and gadgets that emit electromagnetic waves are omnipresent in modern society. They are causing the saturation of the environment with electromagnetic waves that might jeopardize human health emphasizing the need to seek effective electromagnetic shielding materials. This study provides a comparative analysis of the electromagnetic interference shielding effectiveness (EMI SE) of graphene oxide (GO) composites with two distinct silver nanostructures: AgNWs and AgNPs.

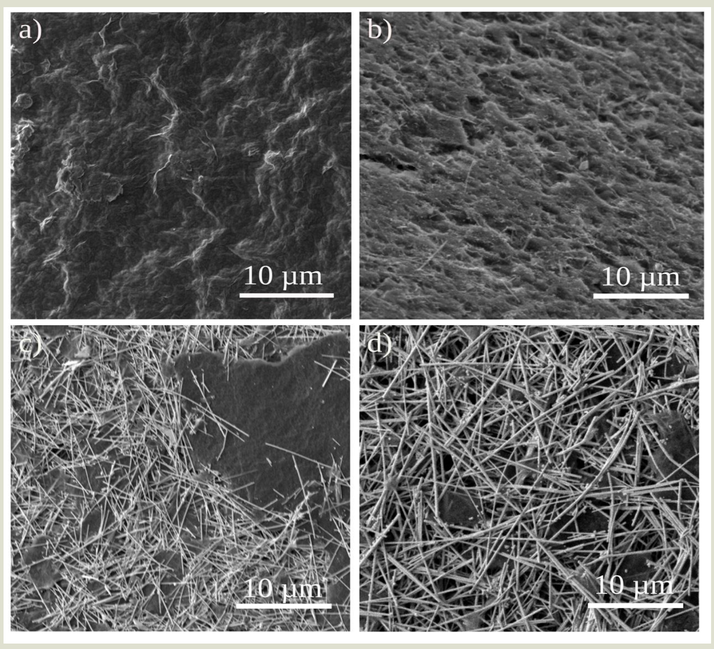

Figure 1. SEM images (top and side view) of free-standing films of GO (a), GO-AgNWs 5:5 (b), GO-AgNWs 3:7 (c), and GO-AgNWs 1:9 (d). Reproduced with permission [1]. Copyright: Int. J. Mol. Sci. 2024

04 CONCLUSION

This work presents a comparative analysis of EMI SE of graphene oxide composites with two different silver nanostructures: AgNWs and AgNPs. GO-AgNW composites showed superior EMI SE compared to their GO-AgNPs counterparts. The difference in EMI SE between GO-AgNWs and GO-AgNPs might be due to the structural differences between Ag nanostructures.

02 MATERIAL AND METHODS

Preparation of GO/AgNW and GO/AgNPs composites

Composites of GO and AgNWs were prepared by mixing the dispersions of GO and AgNWs in different volume ratios, while the composites of GO and AgNPs were prepared by the reduction of silver nitrate by low-dose gamma irradiation in the presence of GO.

03 RESULTS AND DISCUSSION

GO exhibits a sheet-like structure, characterized by a thickness of 1 nm and lateral dimensions ranging from 300 to 800 nm, with a small fraction of GO flakes displaying larger lateral dimensions of up to 1.2 µm (Figure 1a).
AgNWs appear straight and long, with diameters between 100 and 200 nm and lengths of several micrometers (Figure 1b, c, and d). On the other hand, AgNPs are mostly spherical and uniformly distributed over the GO surface (Figure 2). The majority of AgNPs have sizes between 10 and 50 nm, with a certain portion of particles having sizes between 50-100 nm

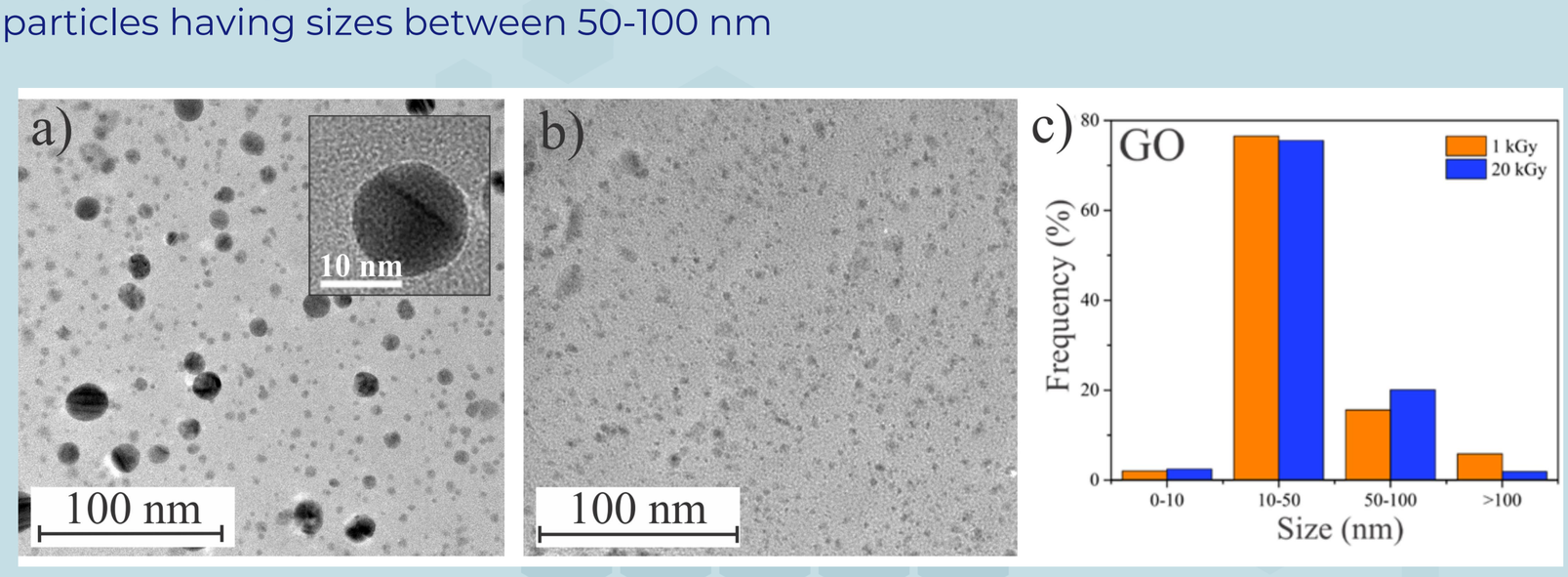

Figure 2. TEM images of (a) GO-AgNPs - 1 kGy, (b) GO-AgNPs - 20 kGy. Reproduced with permission [2]. Copyright: Nanomaterials 2024.

GO shows negligible EMI SE in the 8-12 GHz frequency range. Adding AgNWs to GO greatly improved the EMI SE due to the higher electrical conductivity of AgNWs compared to GO (Figure 3). Composites with higher concentrations of AgNWs exhibit increased total shielding effectiveness and reflective shielding effectiveness (SE_T values of 0.9, 1.4, and 4.0, and SE_R values of 0.4, 0.8, and 2 dB for GO-AgNWs 5:5, GO-AgNWs 3:7, and GO-AgNWs 1:9, respectively).

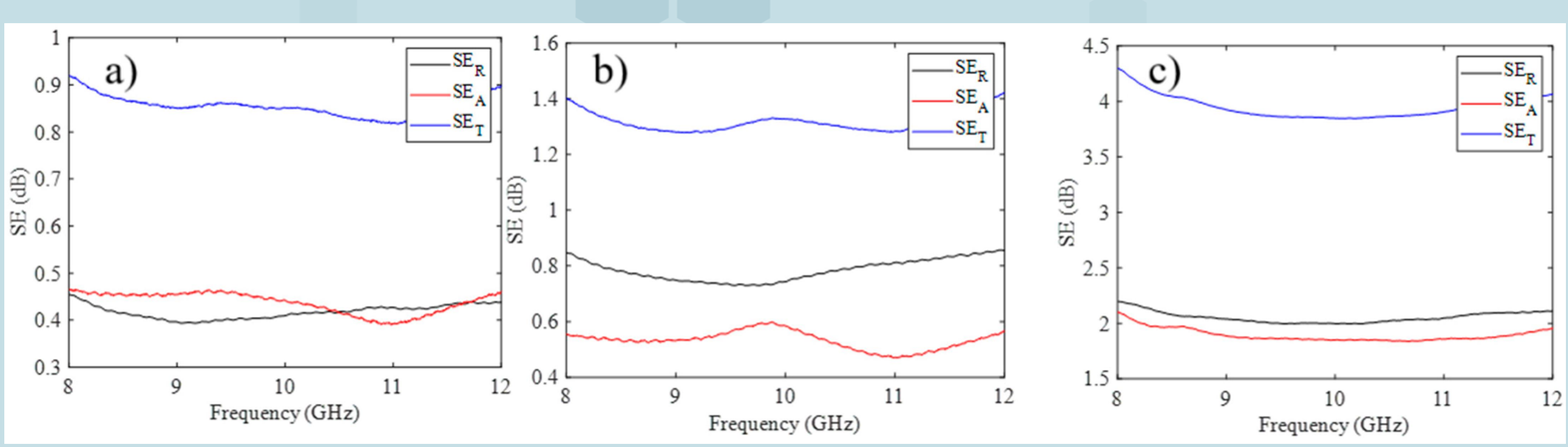

Figure 3. SE_T, SE_A, and SE_R values for GO-AgNWs 5:5 (a), GO-AgNWs 3:7 (b), and GO-AgNWs 1:9 (c), measured in the frequency range of 8-12 GHz. Reproduced with permission [1]. Copyright: Int. J. Mol. Sci. 2024.

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