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Surface Engineering of 3D Hybrid AB_2O_4 (AB = Zn, Co, and Mn) Wrapped on Sulfur Doped Carbon Composite: Investigation on the Role of Electrocatalyst for Antiparasitic Drug Detection

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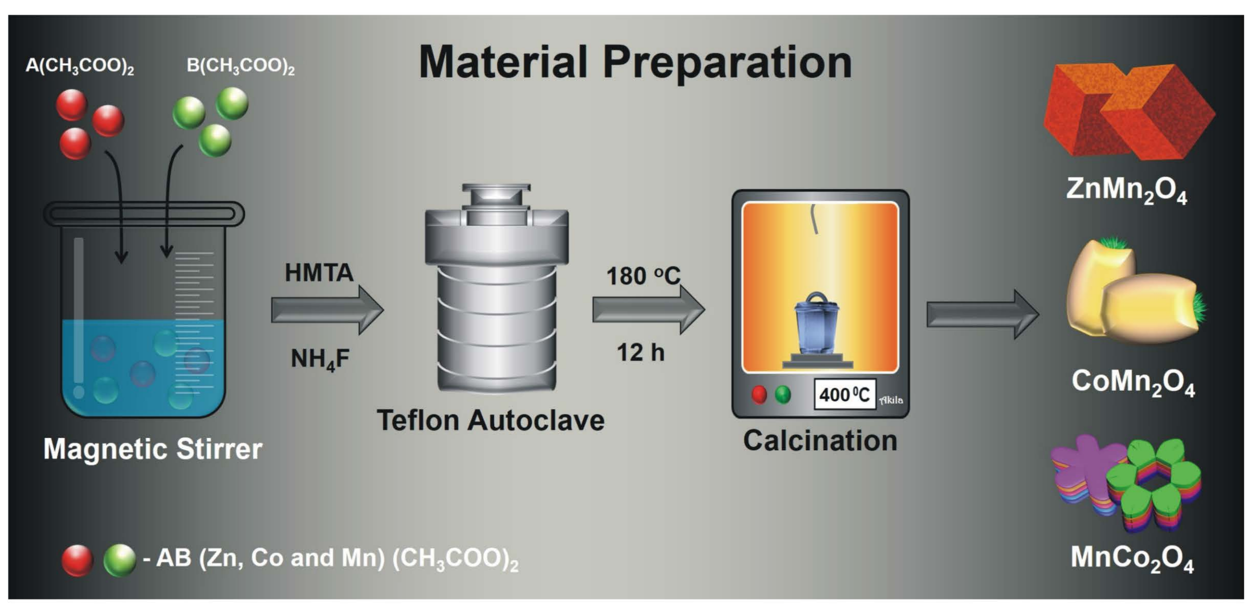
Abstract

- A unique emphasis is placed on the manipulation of these hierarchical structures in the identification and deterioration of trace levels of environmental pollutants.
- Among the large number of chemicals clioquinol, a neurodegenerative medicine can be considered as an emerging contaminant due to its impact on the environment.
- Herein, we report the innovative synthesis of magnificent structures of AB_2O_4 (AB = Zn, Co, and Mn) spinel metal oxide anchored sulfur doped reduced graphene oxide (S-rGO) for the effective detection of clioquinol.
- Fascinatingly, unique tiny-flower like manganese cobaltite (MCO) exhibits superior structural advantages over other spinels and doping of S-rGO into the framework mark significant enhancement of electrochemical properties.
- The unique structural characteristics of the materials can further expand their functions and applications and can significantly elevate and revolutionize the potential of their application accuracy.

KEYWORDS: *3D Hybrid Materials; Hetero Atom Doped Carbon; Flower Morphology; Electrochemical Approach; Biological Samples.*

Synthesis Procedure



Scheme 1. The overall synthesis procedure of AB_2O_4 spinel hybrid materials

Result and Discussions

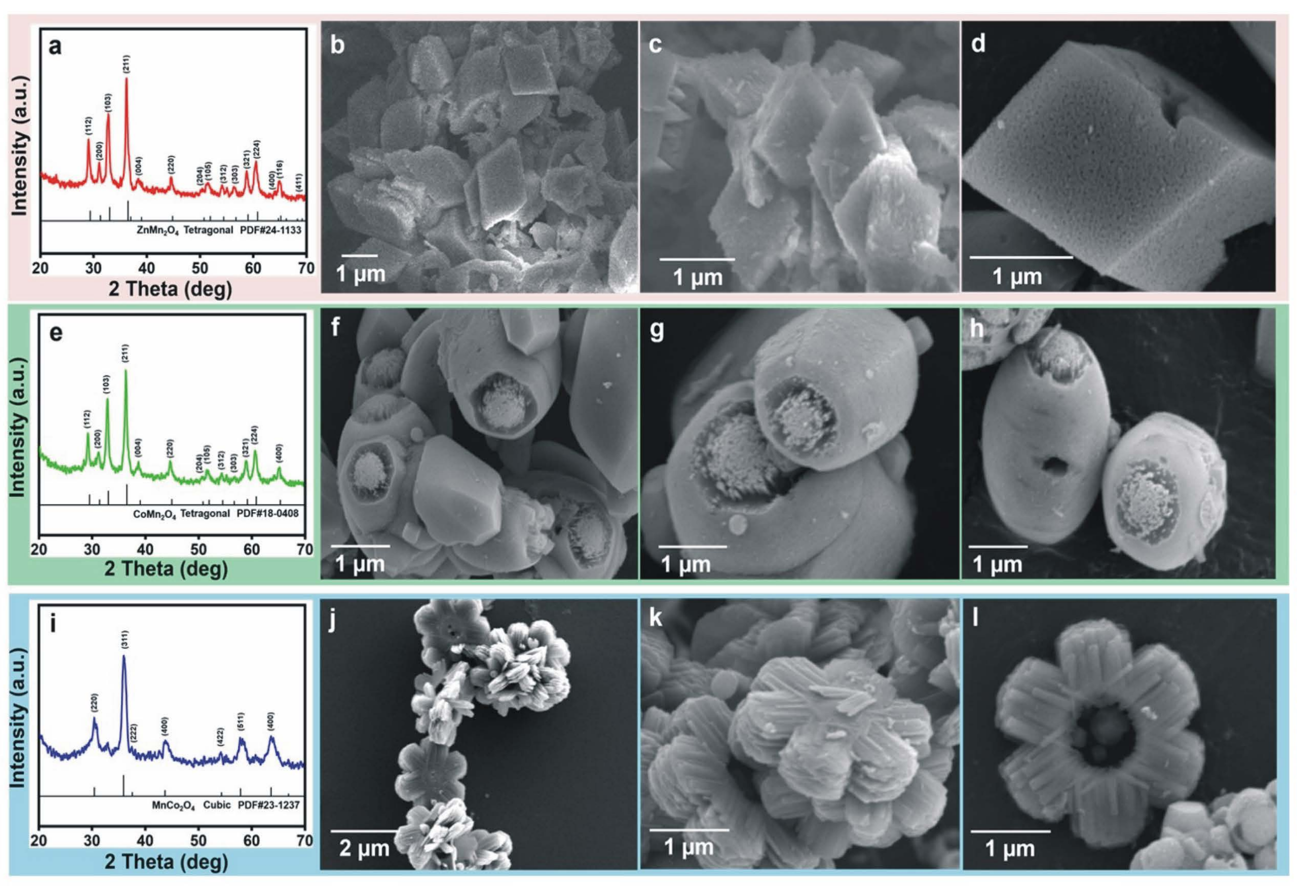
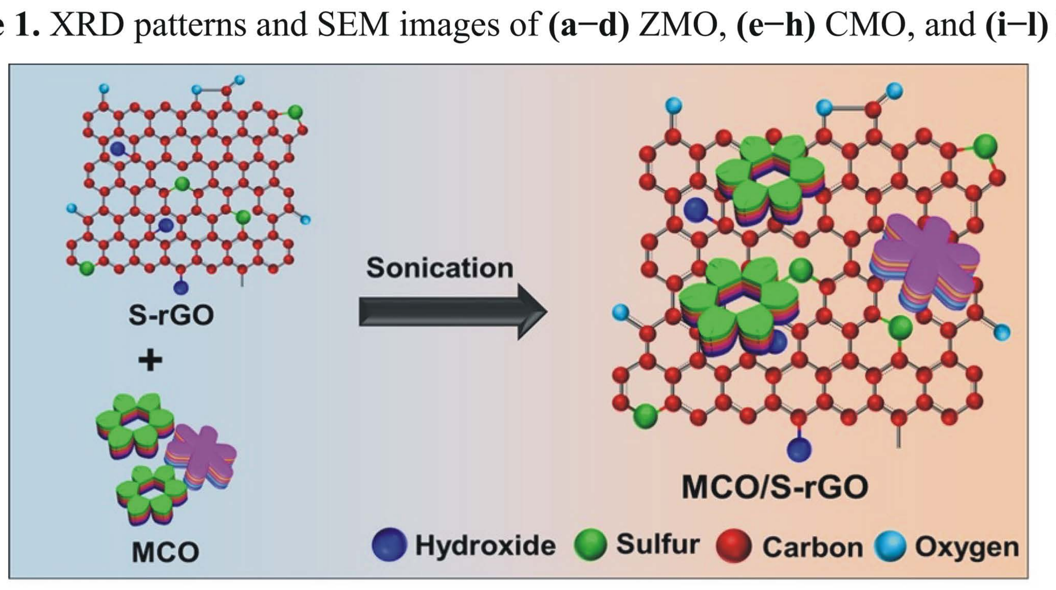


Figure 1. XRD patterns and SEM images of **(a–d)** ZMO, **(e–h)** CMO, and **(i–l)** MCO.



Scheme 2. Preparation of MCO anchored on S-rGO

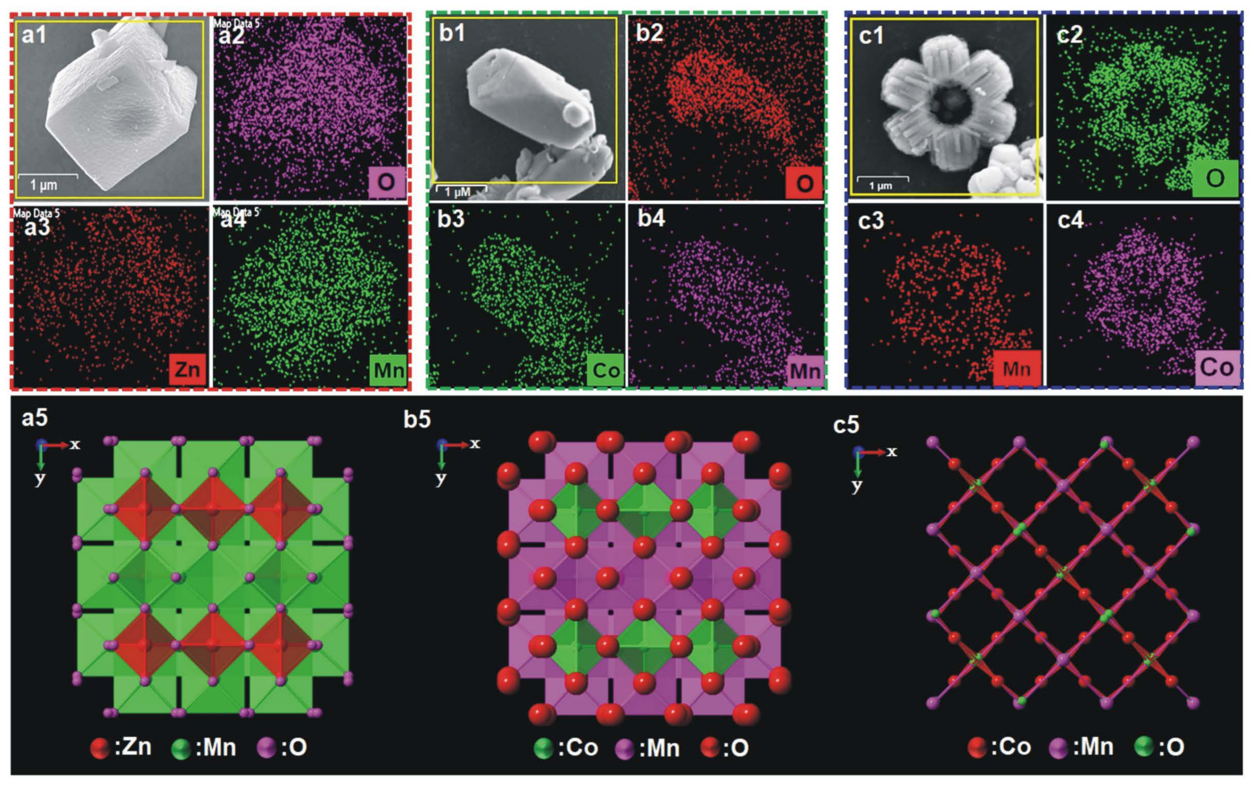


Figure 2. SEM images and elemental mapping of **(a1–a4)** ZMO, **(b1–b4)** CMO, and **(c1–c4)** MCO. Crystal structure of ZMO **(a5)**, CMO **(b5)** and MCO **(c5)** respectively.

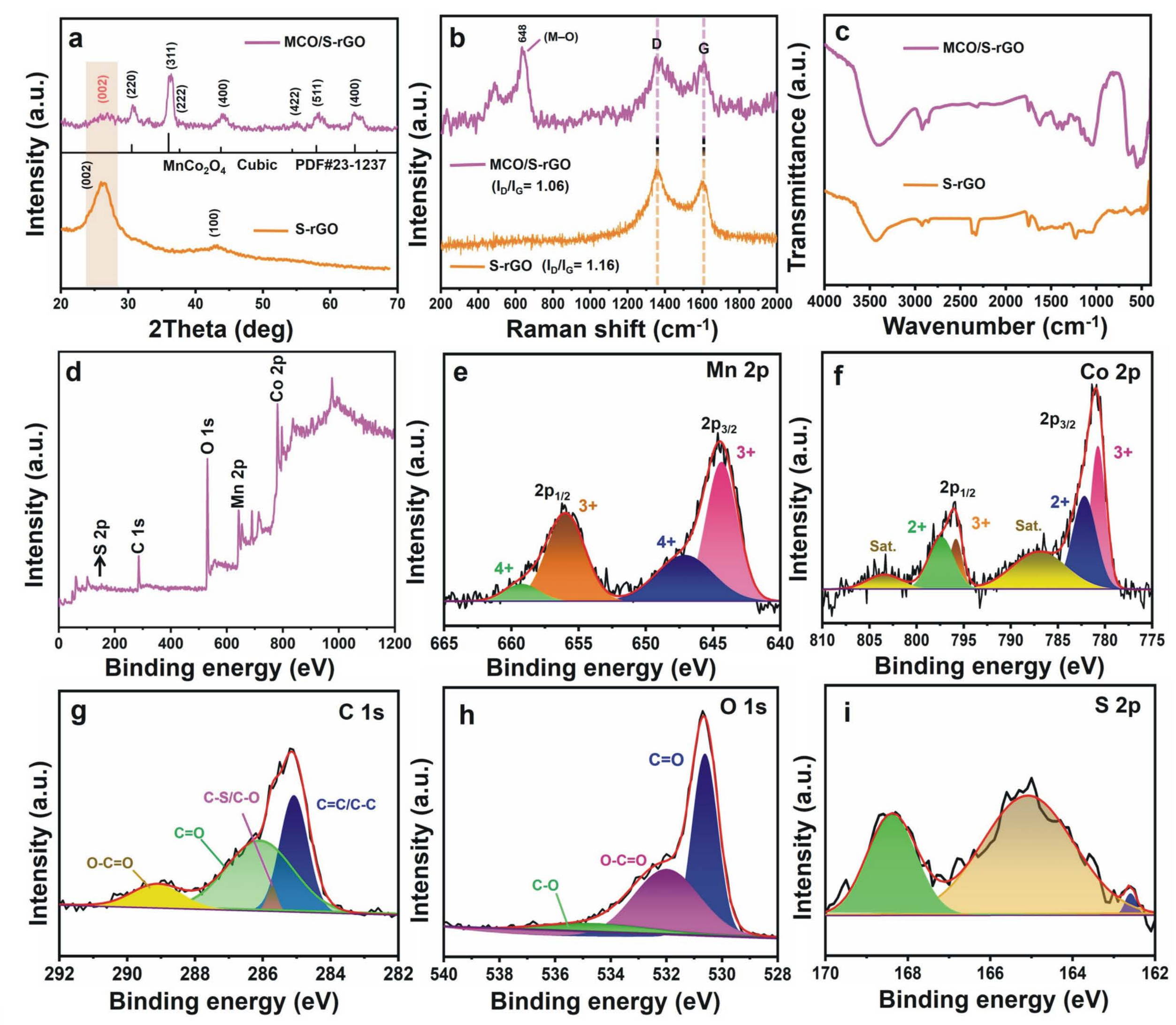


Figure 3. (a) XRD, **(b)** Raman, and **(c)** FTIR spectra of S-rGO and MCO/S-rGO. **(d-i)** XPS spectrum of MCO/S-rGO composite.

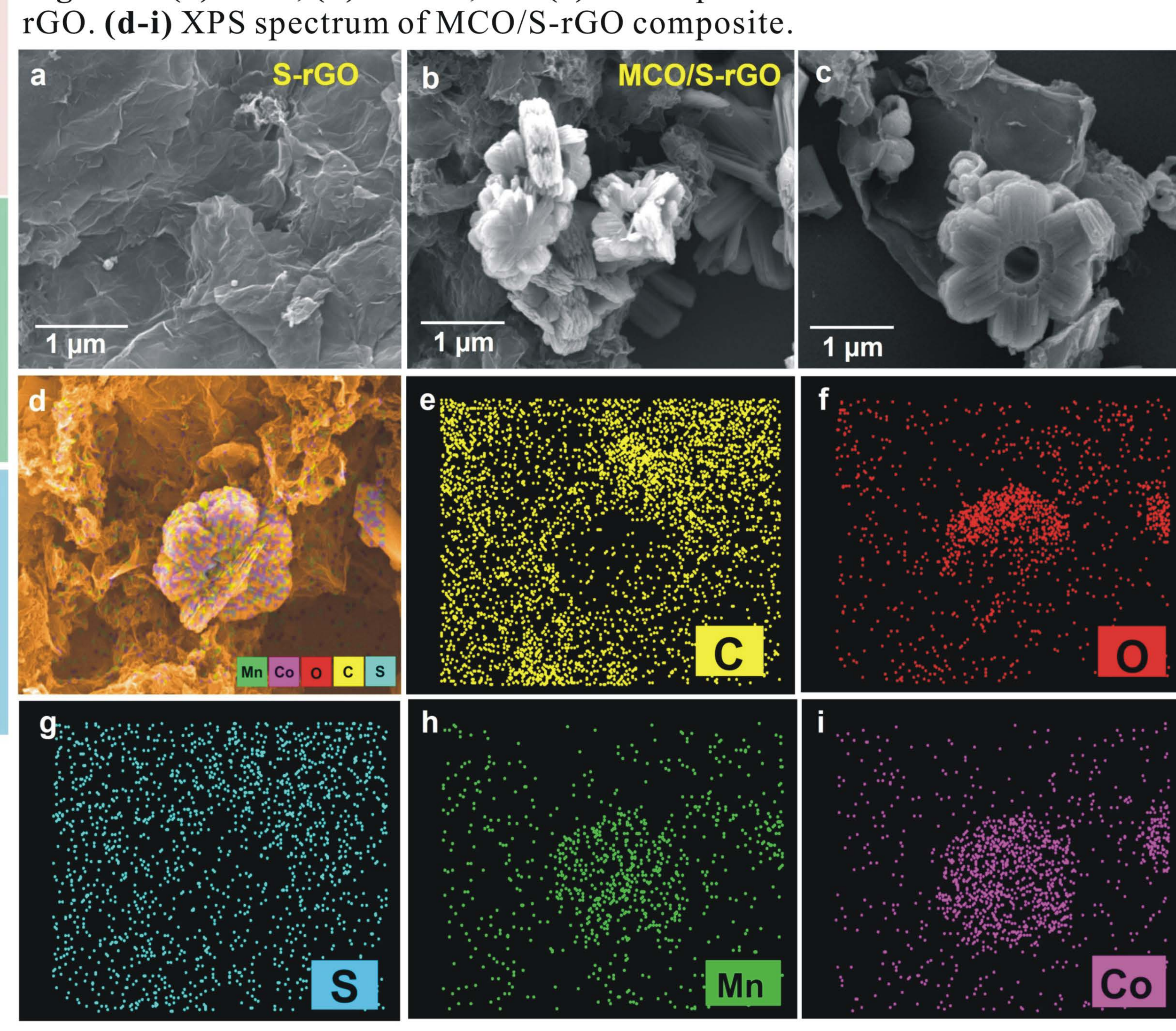


Figure 4. (a-c) SEM images of S-rGO and MCO/S-rGO composite. **(d-l)** Elemental mapping of MCO/S-rGO composite.

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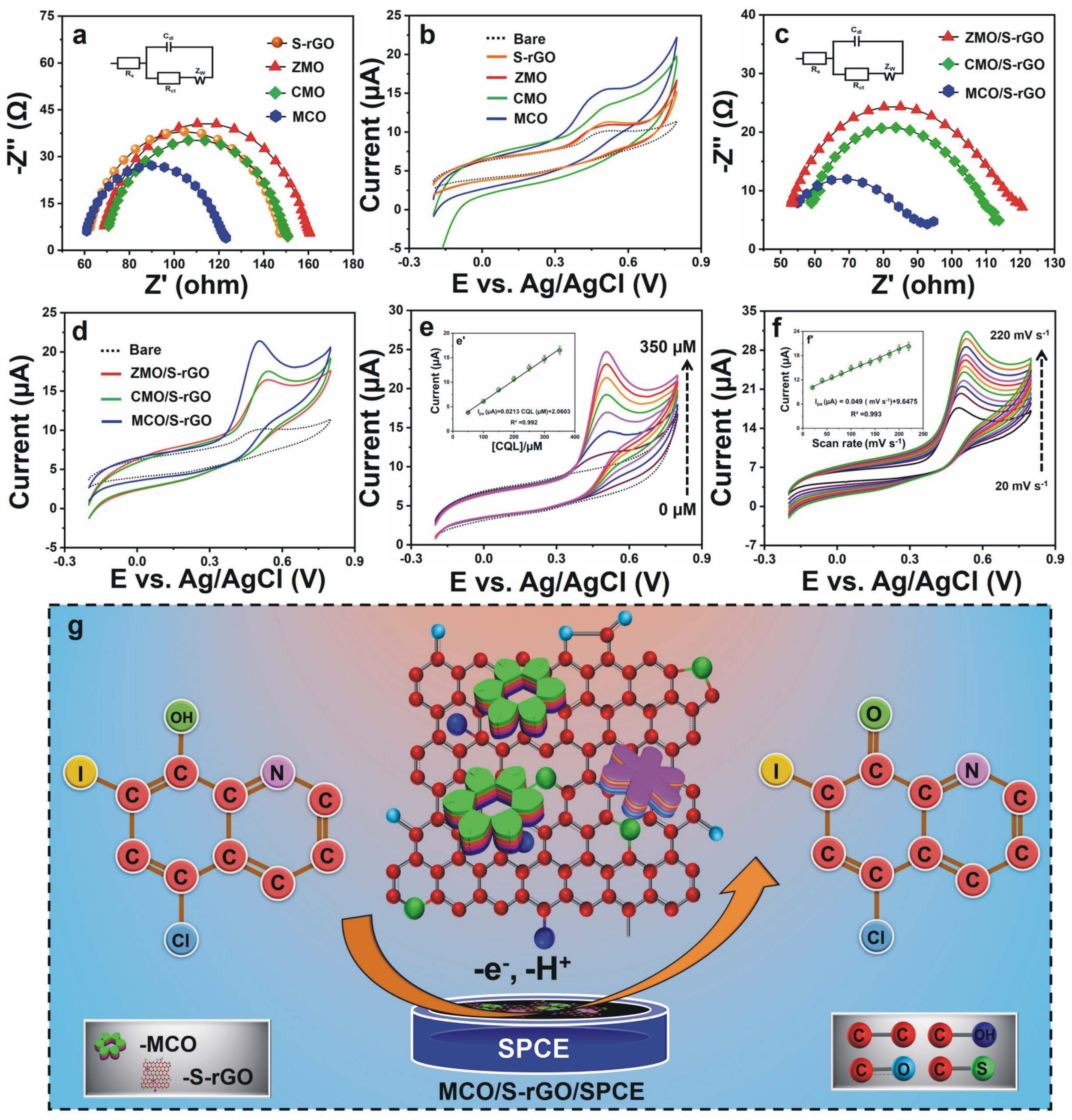

Figure 5. (a and b) EIS and CVs curves of bare SPCE, S-rGO/SPCE, ZMO/SPCE, CMO/SPCE, and MCO/SPCE. (c and d) EIS and CVs curves of ZMO/S-rGO/SPCE,CMO/S-rGO/SPCE, and MCO/S-rGO/SPCE composite. (Inset: Randles equivalent circuit). (e) CVs of different concentrations of CQ at MCO/S-rGO/SPCE in 0.1 M NaOH and (e') calibration plot of [CQ]/μM vs current (μA). (f) CVs of MCO/S-rGO/SPCE containing 100 μM of CQ at different scan rates (20–220 mVs^{-1}) in 0.1 M NaOH and (f') calibration plot scan rate ($mV\ s^{-1}$) vs. currents (μA). (g) Possible electro-oxidation mechanism of CQ towards MCO/S-rGO composite.potential vs. log of scan rate.

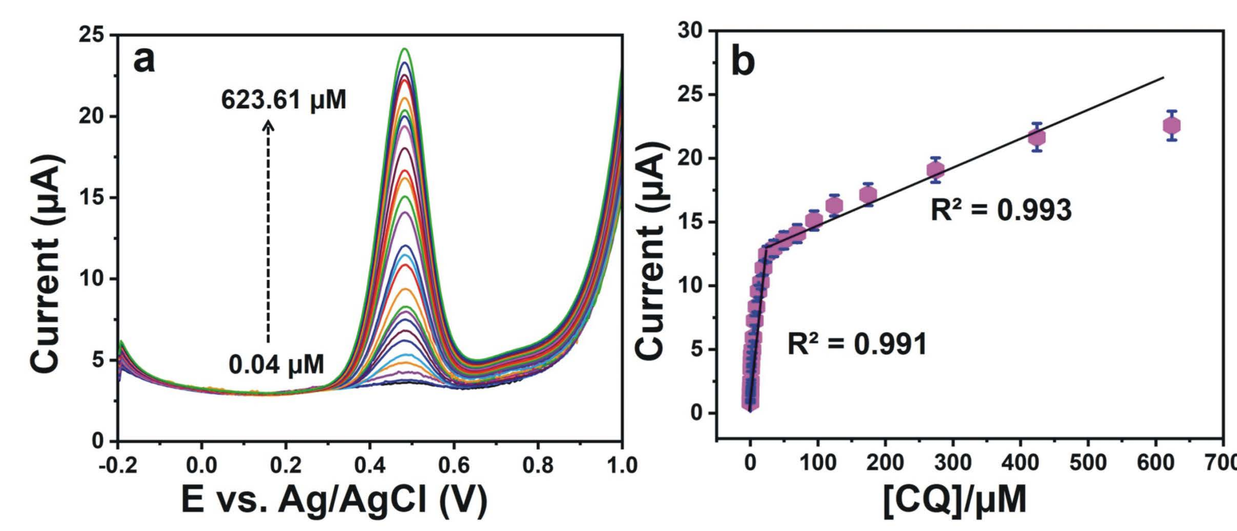

Figure 6. (a) DPV response of MCO/S-rGO/SPCE for the different concentration of CQ from 0.04 to 623.61 μM in 0.1 M NaOH. **(b)** Plot of the electro-oxidation peak current of CQ versus its concentrations

Conclusions

- To summarize, remarkable forms of spinel phase materials, AB_2O_4 (AB = Zn, Co, and Mn) anchored sulfur doped reduced graphene oxide with improved electro-active sites, specific surface area and electrical conductivity are synthesized using a simple synthetic strategy.
- The manipulation of these architectures for electrocatalytic properties establishes their efficient utilization for the detection of CQ.
- Also, the effectiveness and optimized properties of these materials marks them as probable candidates for environmental remediation.

Authors Biography

Mr. Balasubramanian Sriram is currently a Ph.D., Research scholar (Chemical Engineering) in National Taipei University of Technology, Taiwan. He received his B.S degree (Chemistry) and M.S degree (Chemistry) from St. Joseph's College, Trichy, India. His research interests include materials chemistry, deep eutectic solvents-assisted synthesis, nanomaterials synthesis, electrochemical sensors and biosensors, and energy storage applications.

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