Supplementary Information

FT-IR Spectroscopy Analysis

Comparative FT-IR spectroscopy was conducted to investigate the surface functional groups and interfacial interactions in the graphene-coated K_2FeO_4 composite. The typical infrared spectral characteristic peak of the composite appears at around 805 cm^{-1}. A key observation is that, compared to pure K_2FeO_4, this Fe-O characteristic peak exhibits reduced intensity, narrower width, and a distinct shift to a lower wavenumber (redshift). This redshift suggests a modification of the Fe=O bond environment, which is consistent with a strong electronic interaction at the interface, potentially including electron donation from graphene to K_2FeO_4 that contributes to the enhanced stability of the composite.

The characteristic peaks of the composite include the strongest Fe–O bond feature at 780 cm^{-1}, a residual nitrate N–O bond peak at 1236 cm^{-1}, and a peak around 3163 cm^{-1} for the H–O bond of free water. Compared to the pristine K_2FeO_4, the major functional groups are largely preserved. Additionally, two new diffraction peaks appear at 1600 cm^{-1} and 3683 cm^{-1}, which are close to the characteristic peaks of pure graphene, suggesting that graphene functional groups have been successfully incorporated onto the surface of the K_2FeO_4 solid.

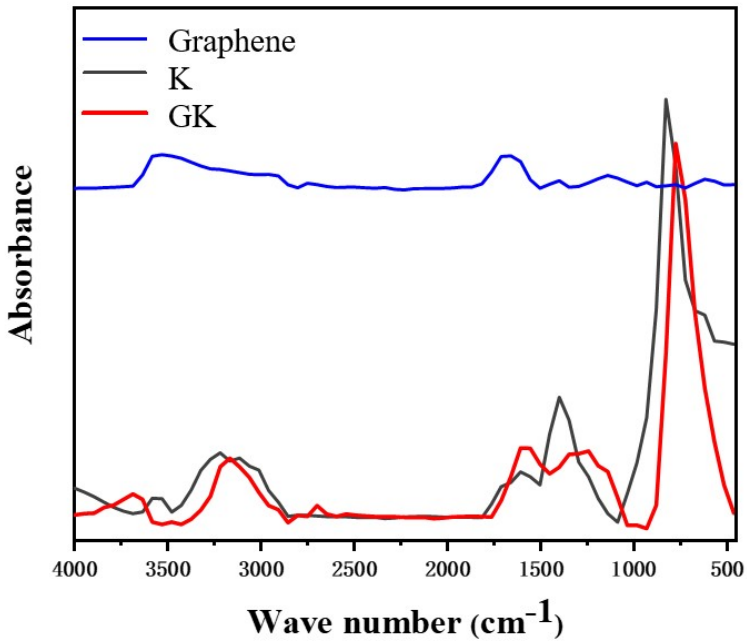

Fig.1 FT-IR spectra of graphene, unmodified K_2FeO_4(K), and graphene-modified K_2FeO_4(GK)

X-ray Diffraction Analysis

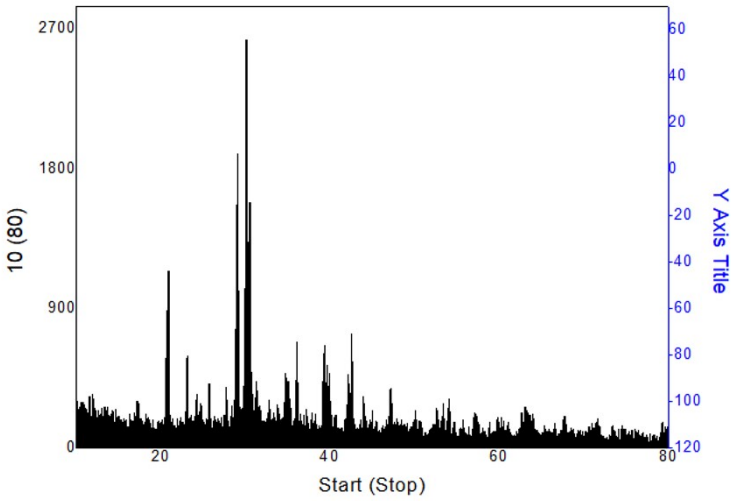

Fig.2 X-ray Diffraction (XRD) pattern of graphene-modified K_2FeO_4(GK)

Successful Coating Formation: The disappearance of the sharp GO peak at ~10.0° and the emergence of a broad RGO halo at ~24.0° quantitatively confirm the reduction of GO and the formation of a poorly ordered, few-layer graphene coating. The calculated d-spacing change from ~0.88 nm to ~0.37 nm provides a key numerical parameter evidencing this transformation.

Crystallite Size Integrity: Application of the Debye-Scherrer equation to the main K_2FeO_4 peaks shows that the average crystallite size remains statistically unchanged after coating. This quantifies that the dramatic surface roughening seen in SEM is due to the graphene deposition and not an alteration of the primary K_2FeO_4 particles.

Phase Purity Assessment: The low intensity of the impurity peak at ~23.5° relative to the main K_2FeO_4 peaks provides a semi-quantitative metric for the material's high purity.