

## Supplementary Material

### **Electrochemical aptasensor for analyzing alpha-fetoprotein using RGO–CS–Fc nanocomposites integrated with gold–platinum nanoparticles**

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## Characterization of the RGO-CS-Fc nanocomposites

SEM is used to display the morphology of different materials. The SEM image of Fig. S1A shows that the RGO surface is relatively flat, and the SEM image of Fig. S1B shows that the surface of RGO-CS-Fc nanocomposites is flaky.

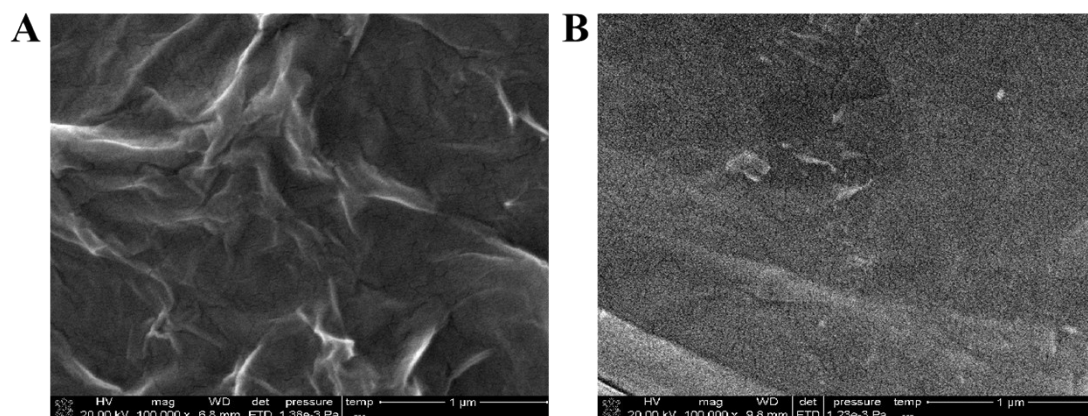


Fig. S1 SEM image of RGO (A) and RGO-CS-Fc (B)

TEM was used to reveal the morphology and structure of the prepared product. The TEM image (Fig. S2A) shows that the RGO lamellar structure, there are many uniformly dispersed small plate-like structures on the surface of RGO-CS-Fc nanocomposites (Fig. S2B), which shows that chitosan and ferrocene formic acid are well combined with RGO.

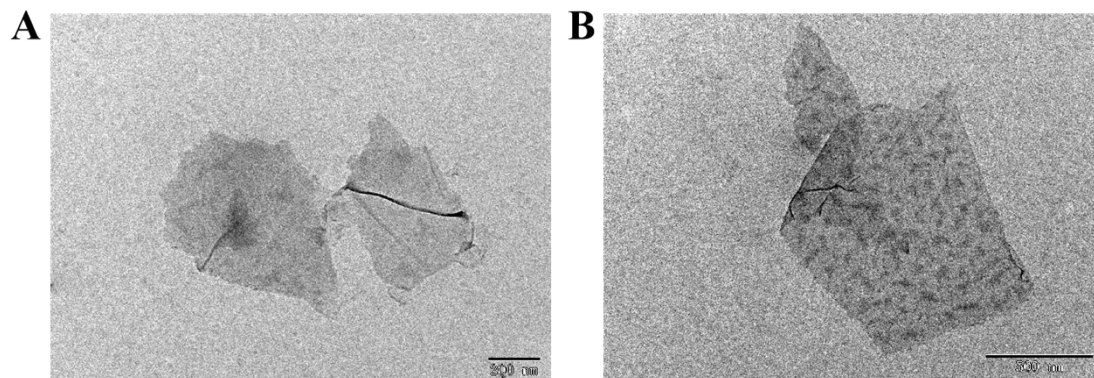


Fig. S2 TEM image of RGO (A) and RGO-CS-Fc(B)

The UV-visible spectrum of Fc (Fig. S3, curve a) shows a characteristic ferrocene peak at 210 nm, and RGO (Fig. S3, curve b) has a clear absorption peak at 265 nm. RGO-CS-Fc nanocomposites (Fig. S3, curve c) shows characteristic absorption peaks at 210 and 267nm. The characterization results indicate that the preparation of RGO-CS-Fc nanocomposites has been successful.

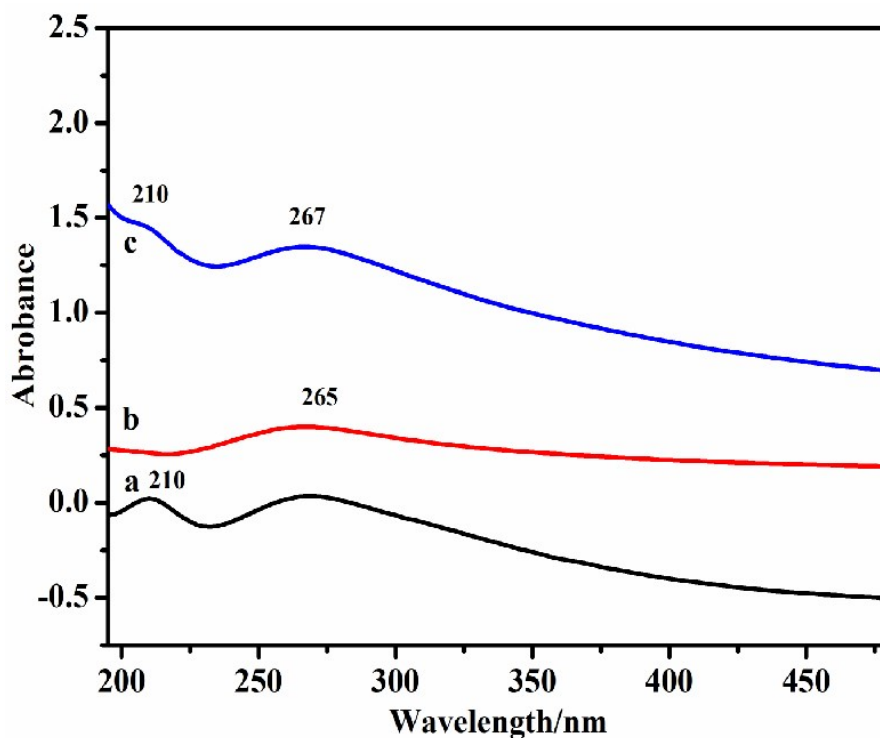


Fig. S3 The UV-visible spectra of Fc (a), RGO (b) and RGO-CS-Fc nanocomposites (c).

Fig. S4 shows the FT-IR Characterization analysis of RGO (Fig. S4, curve a), CS (Fig. S4, curve b), Fc (Fig. S4, curve c) and RGO-CS-Fc nanocomposites (Fig. S4, curve d). The OH stretching vibration peak of RGO is at  $3450\text{cm}^{-1}$ , the C=C vibration peak at  $1635\text{ cm}^{-1}$  (curve a),  $1637\text{ cm}^{-1}$  and  $1384\text{ cm}^{-1}$  (curve b) represent the vibration peaks of N-H and C-N,  $1284\text{ cm}^{-1}$  and  $3448\text{ cm}^{-1}$  (curve c) are COO-antisymmetric vibration and OH stretching vibration, respectively, and  $865\text{ cm}^{-1}$  are characteristic peaks of ferrocene rings.  $1475\text{ cm}^{-1}$  and  $1284\text{ cm}^{-1}$  (curve d) represent the vibration

peaks of N-H and C-O, respectively, and  $835\text{ cm}^{-1}$  are the vibration peaks of ferrocene rings. Curve d has an obvious absorption peak at  $1660\text{ cm}^{-1}$ , which is attributed to the vibrational absorption peak of an amide bond formed by the condensation reaction of -COOH of ferrocene and -NH<sub>2</sub> of chitosan. Therefore, the above infrared spectral characterization results fully demonstrate that the RGO-CS-Fc nanocomposites were successfully prepared.

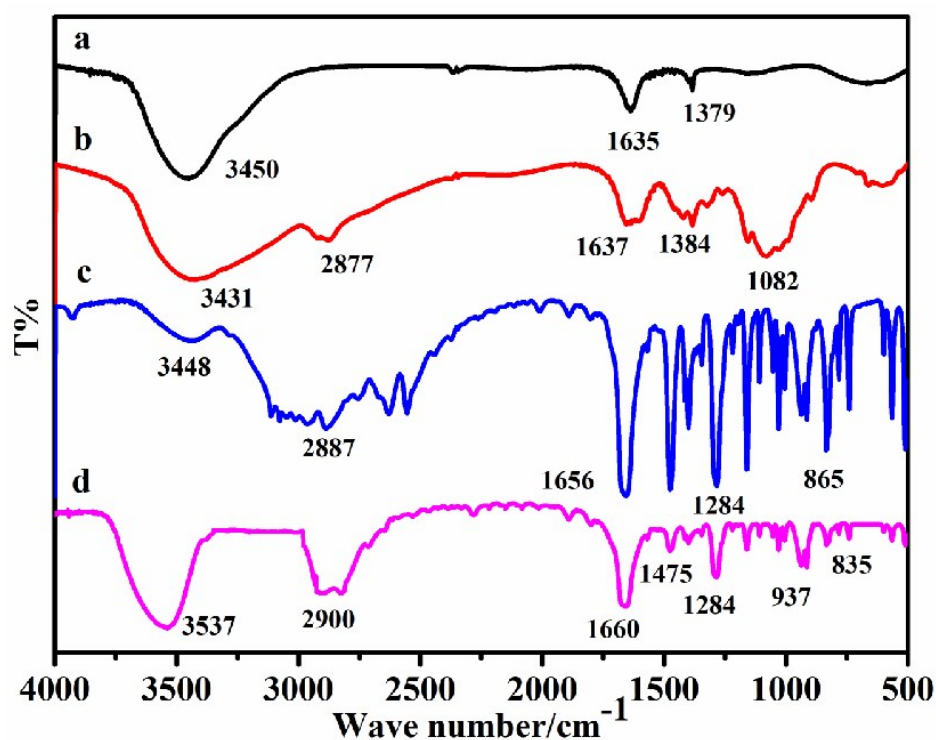


Fig. S4 The FT-IR of RGO (a), CS (b), Fc (c) and RGO-CS-Fc nanocomposite (d).