Supplementary Materials: Three-Dimensional Au/Holey-Graphene as Efficient Electrochemical Interface for Simultaneous Determination of Ascorbic Acid, Dopamine and Uric Acid

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1. Role of PVP

Polyvinyl pyrrolidone (PVP) is a water-soluble polymer made from the monomer N-vinylpyrrolidone. PVP has a structure of a polyvinyl skeleton with polar groups, shown in the formula:

\[
\begin{align*}
\text{PVP} & = \text{(N-} \quad \text{V-P)} \\
\text{N} & \quad \text{(V-P)} \\
\text{N} & \quad \text{(V-P)} \\
\text{N} & \quad \text{(V-P)} \\
\text{N} & \quad \text{(V-P)} \\
\text{N} & \quad \text{(V-P)} \\
\text{N} & \quad \text{(V-P)} \\
\text{N} & \quad \text{(V-P)}
\end{align*}
\]

where \( n \) is the polymerization number.

The advantage of PVP over other water-soluble polymers is that PVP molecules can disperse uniformly on graphene sheets after solvent evaporation, and then turn into three-dimensional structures—a change ascribed to a strong \( \delta-\delta \) interaction between PVP and graphene. By comparison, pure graphene sheets are only connected by a weak physical interaction, which can turn into amorphous structures due to a reduction in the interfacial thermal resistance.

Figure S1 is a three-dimensional (3D) Au/holey-graphene oxide (Au/HGO) self-assembly by Au/HGO protected (a) with PVP and (b) without PVP.

![Figure S1. 3D Au/HGO self-assembly by Au/HGO protected (a) with PVP and (b) without PVP.](image)

2. Preparation of Au/HGO-Modified Glassy Carbon Electrode (Au/HGO/GCE)

A glass carbon electrode (GCE) was polished until mirror-like with 0.3 and 0.05 \( \mu \)m alumina slurry (Beuhler), followed by sonicating in acetone, nitric acid solution (1:1, v/v), and pure water.
Then, 20 μL of 1.0 mg·mL⁻¹ Au/HGO was cast-coated on a clean glass carbon electrode (GCE) (diameter: 3 mm) and dried in air.

**Figure S2.** TEM of Au/HGO Prepared with Different Concentrations of Au Precursor: (a) 5 mM, (b) 10 mM, and (c) 20 mM.