# Supporting Information

# Facile fabrication of g-$C_3N_4$/$Bi_2S_3$ coated melamine foam for oil/water separation applications

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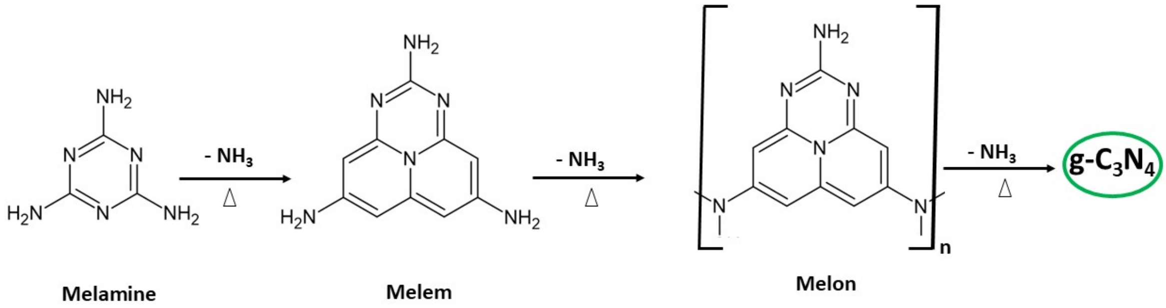
## Preparation of g-$C_3N_4$/$Bi_2S_3$

### Synthesis of g-$C_3N_4$




### Synthesis of $Bi_2S_3$

The hydrothermal synthesis is used to synthesize $Bi_2S_3$.

The main precursors for the synthesis of $Bi_2S_3$ are thiourea $CS(NH_2)_2$, bismuth nitrate pentahydrate ($Bi(NO_3)_3 \cdot 5H_2O$).

The general chemical equation for this hydrothermal synthesis of $Bi_2S_3$ is;

$$2Bi(NO_3)_3 \cdot 5H_2O + 3CS(NH_2)_2 + heat \rightarrow Bi_2S_3 + 6NH_4NO_3 + 3CO_2 + 8H_2O$$

In a hydrothermal reaction, thiourea and bismuth nitrate pentahydrate can be combined in an aqueous solution under elevated temperature and pressure to synthesize bismuth sulfide nanostructures. This reaction typically occurs in a sealed autoclave, where thiourea acts as a sulfur source, decomposing into sulfide ions in solution.

In this process, $Bi(NO_3)_3 \cdot 5H_2O$ provides the $Bi^{3+}$ ions. The thiourea decomposes under hydrothermal conditions, releasing $S^{2-}$ ions that combine with $Bi^{3+}$ to form $Bi_2S_3$. Ammonium nitrate ($NH_4NO_3$), carbon dioxide ($CO_2$), and water ($H_2O$) are byproducts.

Moreover, the combined action of furfuryl alcohol and HCl was used to tune the wettability property of $Bi_2S_3$. Due to the formation of poly(furfuryl alcohol) (PFA), $Bi_2S_3$ becomes hydrophobic.

$$\mathrm{Bi_2S_3 + Furfuryl\ Alcohol + HCl \rightarrow Bi_2S_3/PFA}$$

This reaction does not chemically alter $Bi_2S_3$ but instead coats it, providing the desired surface properties through the PFA structure.

**Synthesis of g-$C_3N_4$/$Bi_2S_3$ binary composite**

The binary composite is prepared using the hydrothermal method.

$$\mathrm{2Bi(NO_3)_3 \cdot 5H_2O + 3CS(NH_2)_2 + g\text{-}C_3N_4 + heat \rightarrow Bi_2S_3/g\text{-}C_3N_4 + 6NH_4NO_3 + 3CO_2 + 8H_2O}$$

These are the basic chemical equations related to synthesizing the product.

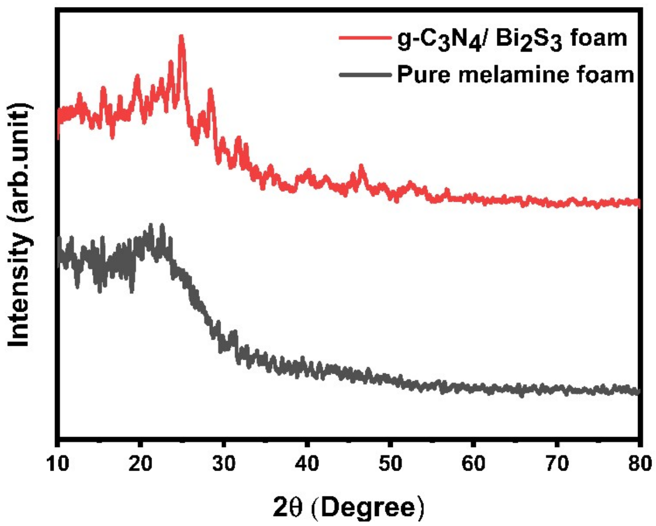



**Figure S1.** XRD patterns of pure melamine foam and g-$C_3N_4$/$Bi_2S_3$ foam.

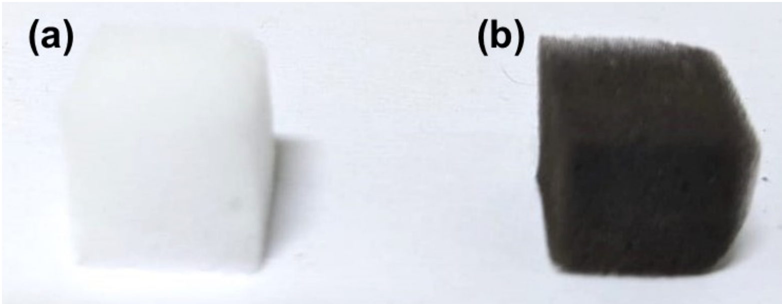



**Figure S2.** Photographs of pure melamine foam and g-$C_3N_4$/$Bi_2S_3$ foam.

Figures S1 and S2 show the successful coating of g-$C_3N_4$/$Bi_2S_3$ binary composite on pure melamine foam.

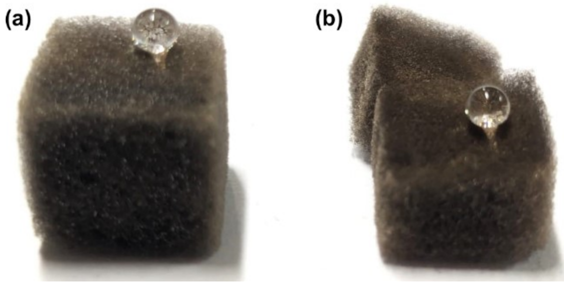



**Figure S3.** Wettability test (a) on the outer surface of the g-$C_3N_4$/$Bi_2S_3$ foam and (b) the inner surface of g-$C_3N_4$/$Bi_2S_3$ foam (foam cut into two parts and checked its wettability).

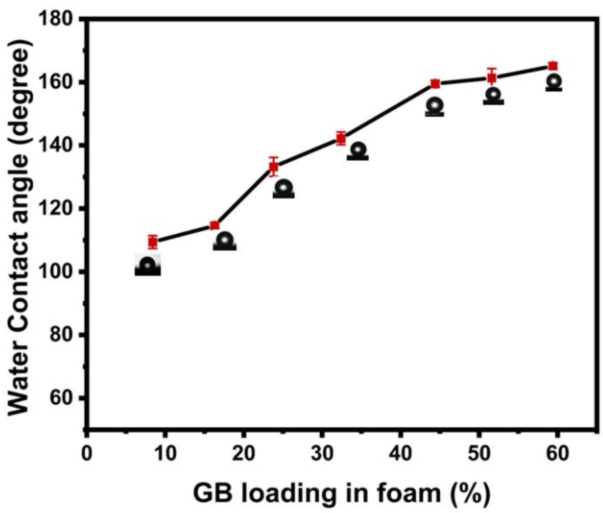



**Figure S4.** Water contact angle obtained for different GB loadings in the melamine foam.

The loading percentage of g-$C_3N_4$/$Bi_2S_3$ was determined using Equation 1 by measuring the weight of the melamine foam before and after GB loading. Figure S4 depicts the WCA for the g-$C_3N_4$/$Bi_2S_3$ foam at various particle-loading percentages. Increasing the nanoparticle loading resulted in an increase in WCA; however, excessive loading eventually led to a reduction in oil absorption capacity due to particle-induced pore blockage.

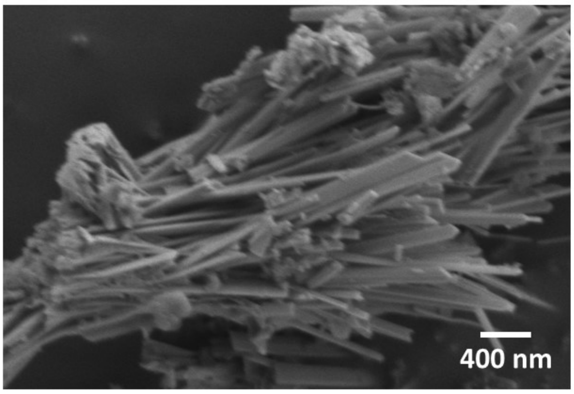



**Figure S5.** SEM image of g-$C_3N_4$/$Bi_2S_3$ particles.

Video S5.mp4

**Video S6.** Engine oil removal from water using g-$C_3N_4$/$Bi_2S_3$ foam.

The absorption capacity of the g-$C_3N_4$/$Bi_2S_3$ foam was assessed by immersing it in water contaminated with engine oil and manually squeezing it. The g-$C_3N_4$/$Bi_2S_3$ foam effectively absorbs the engine oil. Experimental results indicate that the g-$C_3N_4$/$Bi_2S_3$ foam exhibits excellent recyclability, maintaining its oil removal efficiency even after 20 cycles, without any significant weight loss.

Video S6.mp4

**Video S7.** Continues engine oil/water separation using a peristaltic pump.

The video demonstrates a single-step separation of engine oil from water utilizing the GB foam. A continuous separation of 25 mL of engine oil was achieved using a peristaltic pump, without loss of loaded material.