Electronic Supplementary Information

for

Highly Impermeable and Transparent Graphene as Ultra-Thin Protection Barrier of Ag thin Films

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Before corrosion tests, pristine Ag/G sample (Figure S2(a)) is as clean and shiny as bare Ag sample (Figure S2(b)) because the transmittance of graphene is up to 97.73% in the visible regime. Figure S2(c) and S2(d) show the optical images of the Ag and Ag/G samples after the heat treatment in air, respectively. There are some black dots on the surface of the Ag sample. In comparison, Ag/G sample almost show no change after the heat treatment in air except the appearance of very few dots, indicating graphene protective barrier is highly impermeable to the atmospheric air.

After the strong oxidation treatment, the morphologies of the Ag and Ag/G samples show dramatic changes. Figure S2(e) shows the optical image of Ag sample after the H_2O_2 dip. The surface of Ag sample becomes totally tarnished because of the oxidation of Ag in the strong oxidant. For the Ag/G sample after H_2O_2 dip, only a few dots appeared on the surface. The presence of graphene protective barrier eliminates the diffusion paths of gas and liquid. However, under high oxidizing environment, the grain boundary and defective sits of graphene can be enlarged, which allows H_2O_2 to penetrate through them, and react with the underneath Ag thin film.

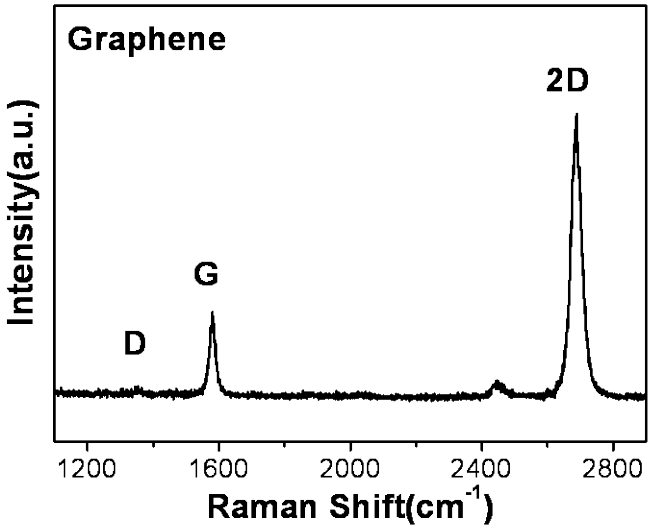

Figure S1. A representative Raman spectrum of monolayer graphene on SiO_2/Si substrate. The high 2D/G peak intensity ratio and sharp G and 2D peak indicate that the as-grown graphene is monolayer. The negligible D peak shows that graphene is less defective.

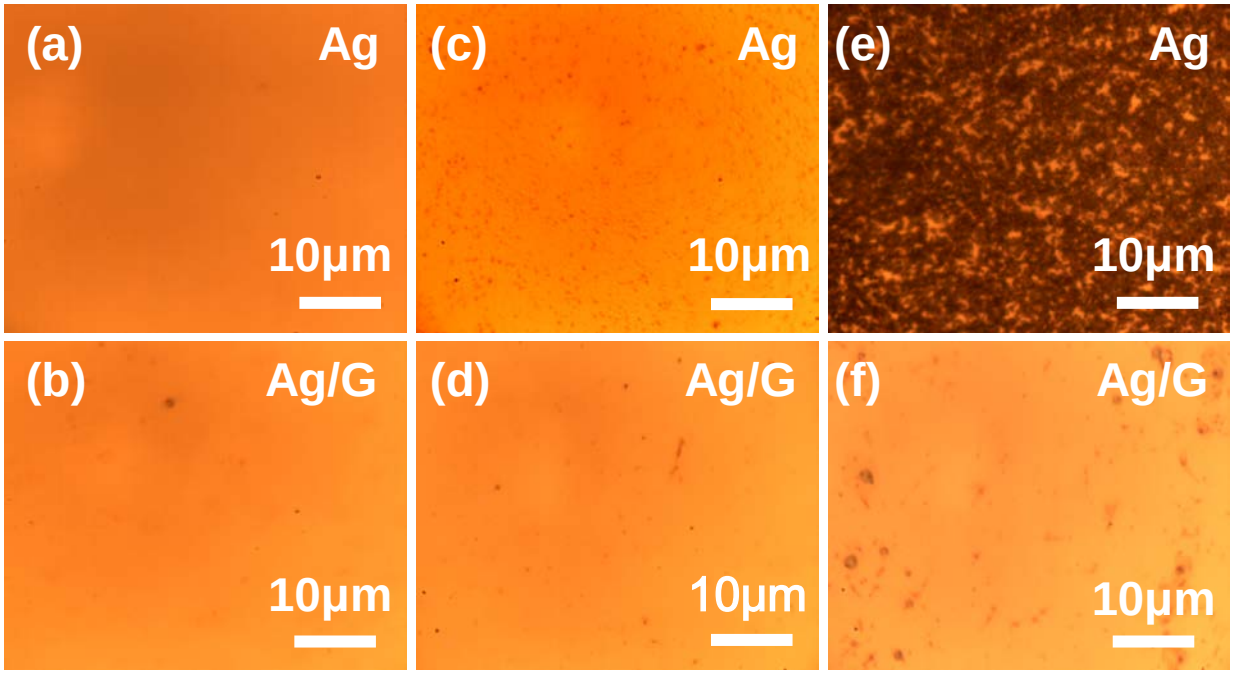

Figure S2. Optical images of bare Ag film (Ag) and Ag film with graphene coating (Ag/G). (a, b) pristine film, (c, d) after heat treatment in air at 150 ºC for 5 hours, (e, f) after dip in 34.5% H_2O_2 aqueous solution for 2 min.