Supporting Information

Graphene-inspired quasi-two-dimensional gold films

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Supplementary Note 1

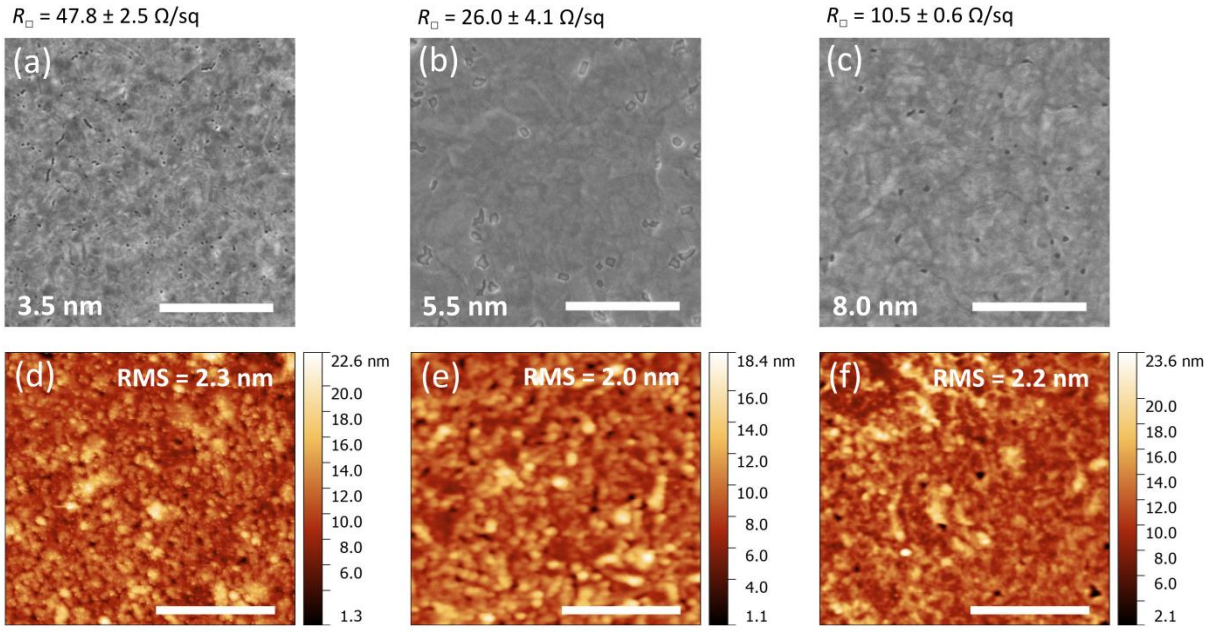

Figure S1| Structural morphology characterization and values of sheet resistance of quasi-2D gold films with three different thicknesses 3.5, 5.5, and 8.0 nm transferred onto a glass substrate by using Cu/SiO_2 initial substrate (SiO_2/Si wafer without graphene). SEM images (a-c) of the film's surface (scale bars are 500 nm) and AFM (d-f) scan images (scale bars are 500 nm) along with root-mean-square (RMS) values of surface roughness (right upper angle).

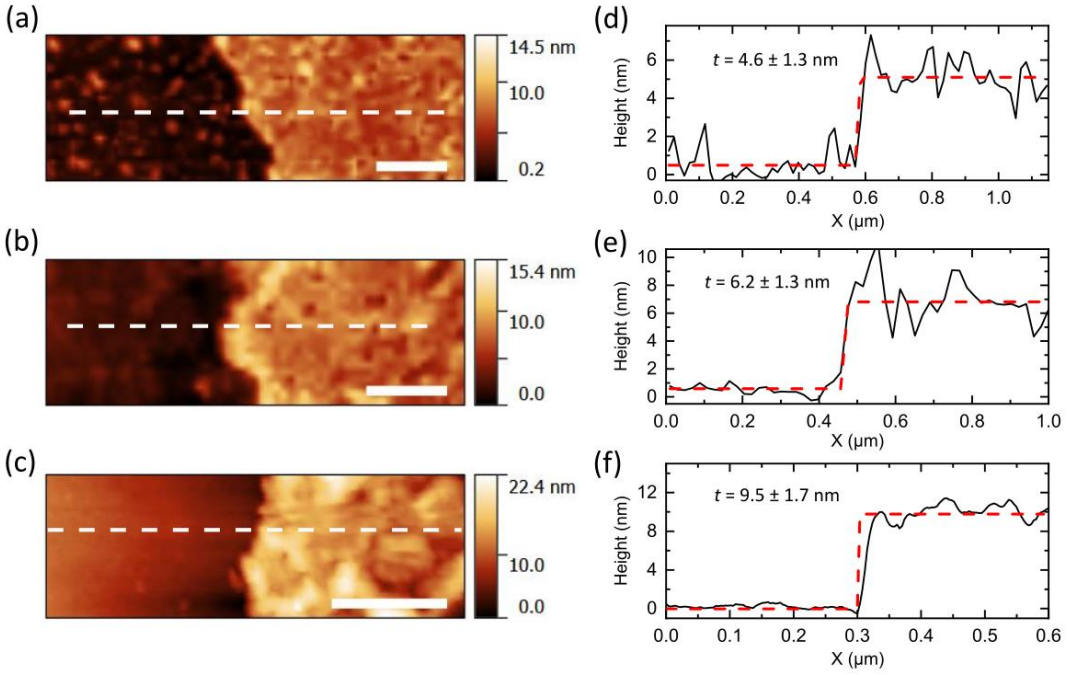

Figure S2| Measurements of quasi-2D gold film thicknesses transferred onto glass by the direct step height AFM scan on the area of film's scratch. AFM images of the steps in Au films of mass equivalent thicknesses 3.5 nm (a), 5.5 nm (b) and 8.0 nm (c). All scale bars are 200 nm. Respective step height profiles of 3.5 nm (d), 5.5 nm (e) and 8.0 nm (f) thick Au films.

In our measurements AFM thickness scans provided slightly larger values than mass-equivalent thicknesses. This fact might be attributed to the influence of the rough surface of transferred Au films. RMS surface roughness might give a non-uniform clearance of ~1 nm between glass and Au film. However, averaged AFM step heights results in Figure S3d-f correlate well with mass-equivalent values.

Supplementary Note 2

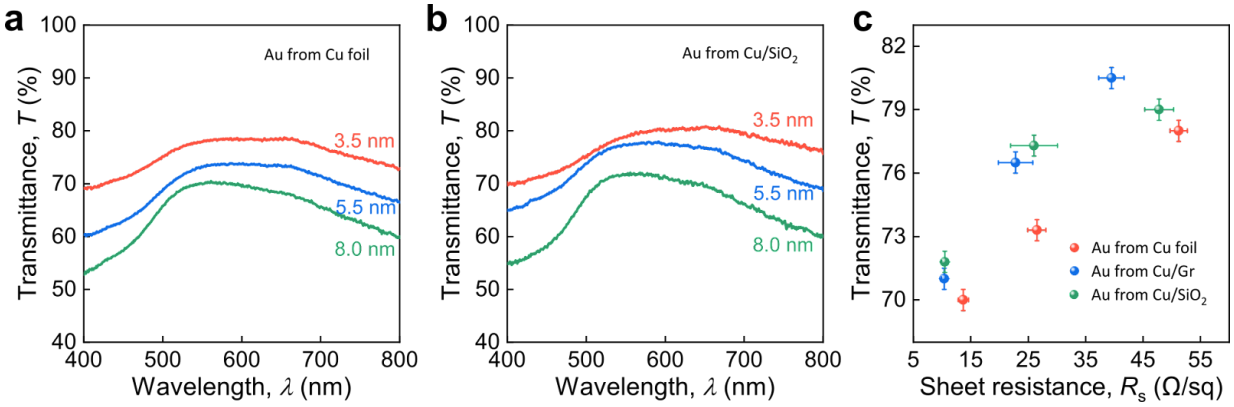

Figure S3| Optoelectronic properties of quasi-2D gold films. Absolute optical transmission of gold films with different thicknesses transferred from substrates of Cu/Gr (a) and (b) Cu/SiO_2. (c) Sheet resistance vs optical transmittance measurements of quasi-2D gold films (T at λ = 550 nm).

Absolute transmittance and sheet resistance measurements of quasi-2D gold films transferred from Cu/SiO_2 initial substrate demonstrate similar results compared to quasi-2D gold films obtained from Cu/Gr substrate (see Figure S4). However, practically the presence of graphene underlayer (Cu/Gr) provides much easier electrochemical delamination of the Au/Cu(500nm) stack and results in better quality of the transferred films.

Supplementary Note 3

The chemical purity of the transferred Au films was analyzed by X-ray photoelectron spectroscopy (XPS) taken from folded areas on the film's edges, whose surface should be the bottom side of the film. We have performed XPS spectra measurements and studied the content of elements of Au and Cu in ultrathin films transferred on glass substrate. Figure S1 demonstrates the result of XPS analysis for the elements. The XPS spectrum shows the gold XPS peaks and the absence of copper residues. The performed XPS analysis proves that copper is completely dissolved from gold in the film's fabrication stage shown in Figure 1a-5. Peak positions and designations denoted in Figure S1 were found using Avantage Data System software (Thermo Scientific). As a result, the measured XPS spectra did not reveal residuals of Cu element after the dissolution of the 500-nm-thick copper layer, which could remain after etching in ammonium persulphate. The measured XPS spectrum demonstrates only peaks of gold, thus confirming the purity of transferred films.

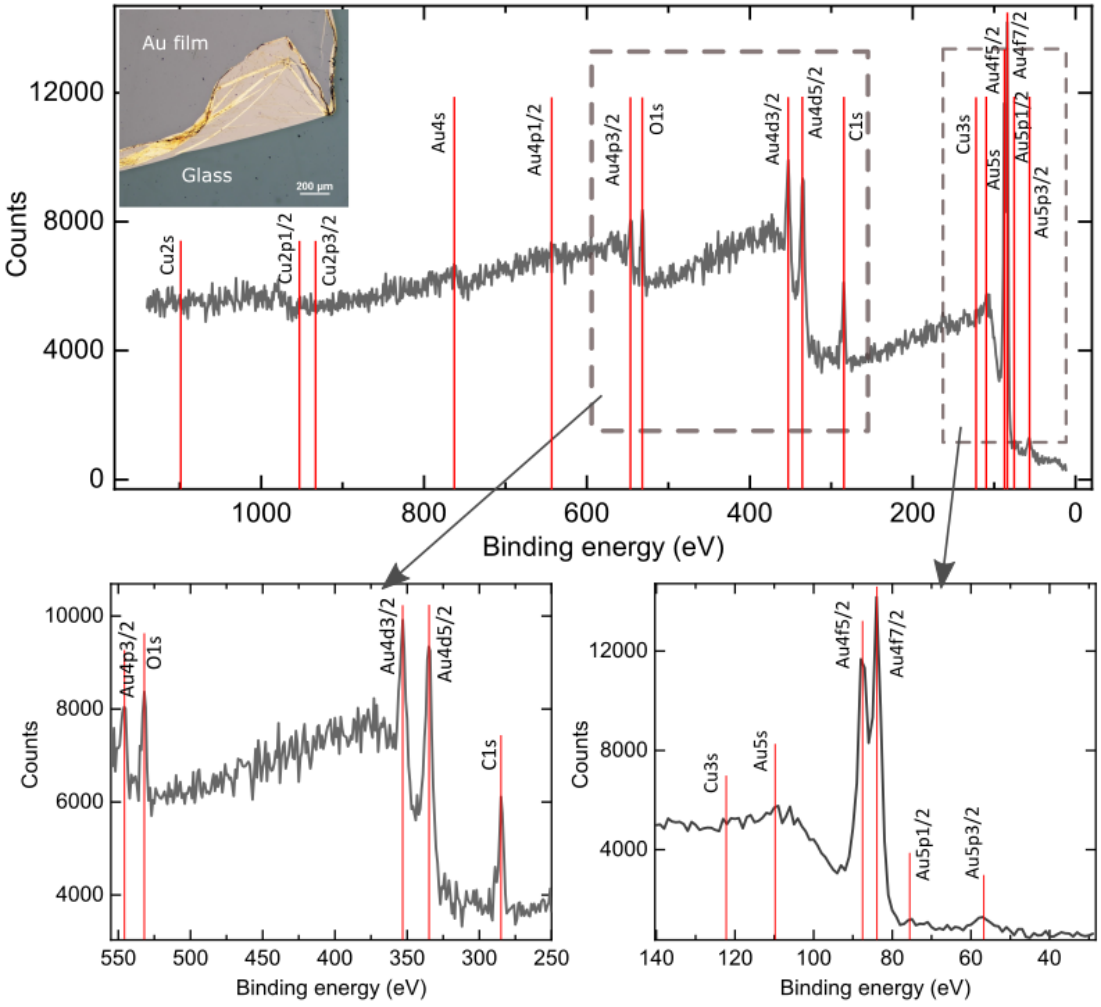

Figure S4| XPS spectrum of Cu and Au elements taken from the folded areas on Au film's edges, in which the underside of the gold film is on top (see optical image in the inset).