

Figure S1. (a) Absorption and (b) transmittance spectra of the as-deposited metallic thin films: 10 nm Au thin films (Au-1), 20 nm Au thin films (Au-2), and Al-Au bimetallic thin films with the total thickness of 20 nm. (c) Transmittance spectra of the samples after annealing. (d) Plots of the corresponding transmittance average values.



Figure S2. The XPS survey scan spectra of the Au-Al thin films (a) before and (b) after annealing. The corresponding XPS (a-1) - (b-1) Al peaks and (a-2) - (b-2) Au peaks.



Figure S3. (a) SEM image of the Au-Al thin films annealed at 700°C with the total deposition thickness of 20 nm. (b) - (c) The elementary maps of the Au-Al thin films. (e) EDS spectra of the sample.



Figure S4. (a) Transmittance spectra of the Au-Al bimetallic thin films annealed at different temperatures. (b) The corresponding average values between 300 and 1200 nm.



Figure S5. SEM images of 20 nm Al-Au bimetallic thin films annealed at different temperatures for 900 s: (a) as-deposited, (b) 400 °C, (c) 600 °C and (d) 700 °C.



Figure S6. (a) Optic photos of the transparent Au-Al electrodes and normal Au electrodes with an identical thickness of 20 nm deposited on P-type silicon and glass (below). (b) I-V curves of the silicon substrates with different electrodes.



Figure S7. Schematic illustration of the real-time resistance measurement system.