Supporting Information

Thermally Stable Au-$BaTiO_3$ Nanoscale Hybrid Metamaterial for High Temperature Plasmonic Applications

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Transmittance (T%) spectra

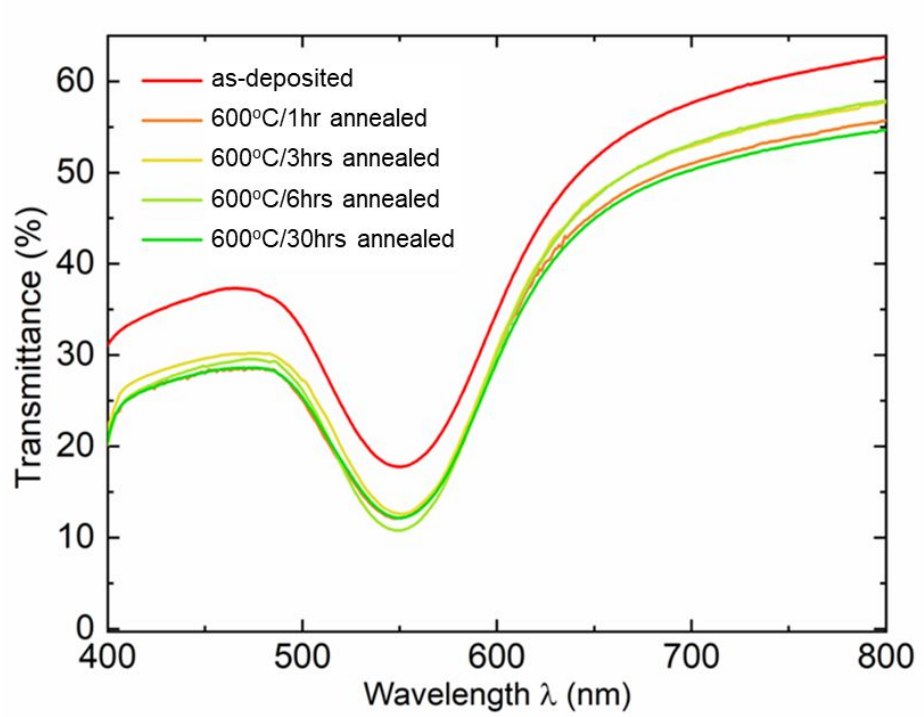
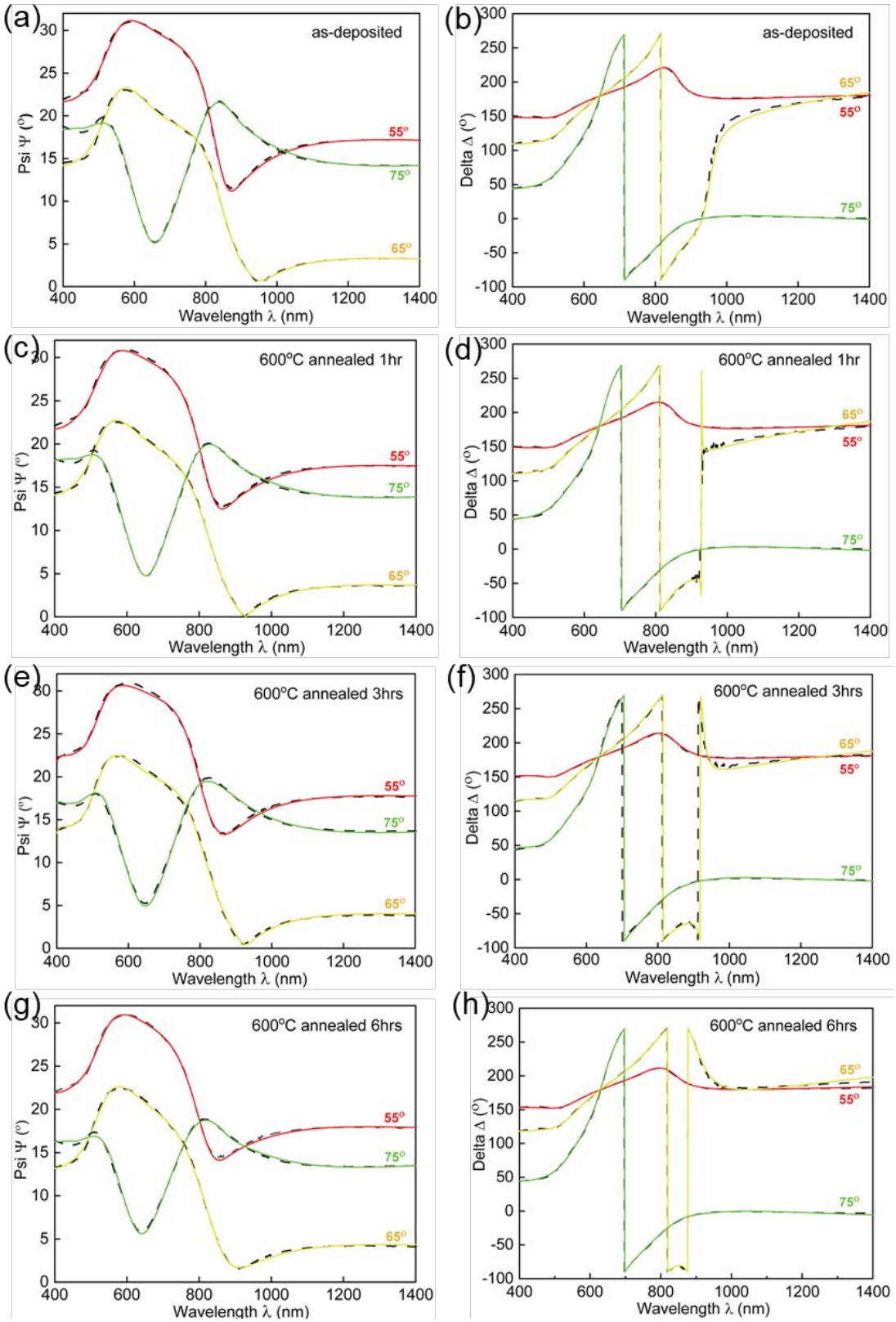


Figure S1. Transmittance (T%) spectra of the as-deposited and 600°C annealed for different periods (1, 3, 6, 30 hrs) Au-BTO hybrid thin films.

Experimental and fitted ellipsometric parameters Psi (Ψ) and Delta (Δ)



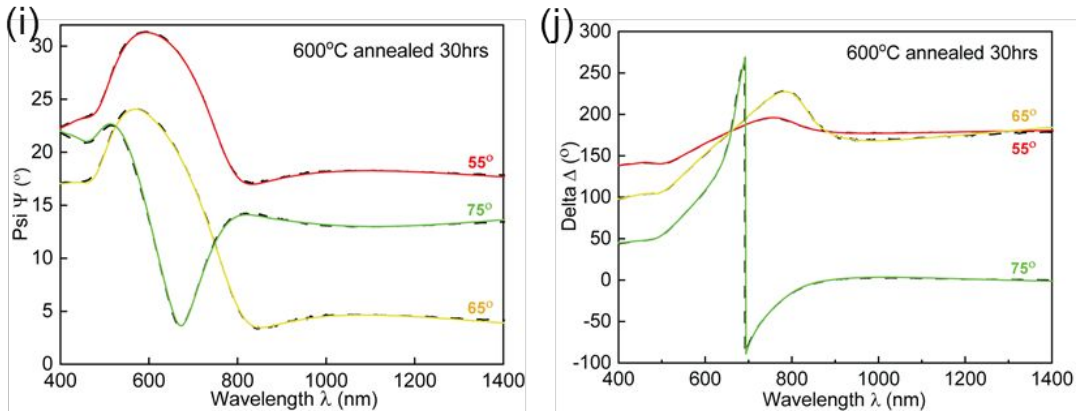


Figure S2. Experimental (dashed) and fitted (solid) ellipsometric parameters Psi (Ψ) and Delta (Δ) with 55°, 65°, 75° incident angles for (a,b) as-deposited, (c,d) 600°C/1hr, (e,f) 600°C/3hrs, (g,h) 600°C/6hrs and (i,j) 600°C/30hrs annealed Au-BTO thin films.

Imaginary part (Im) dielectric permittivity

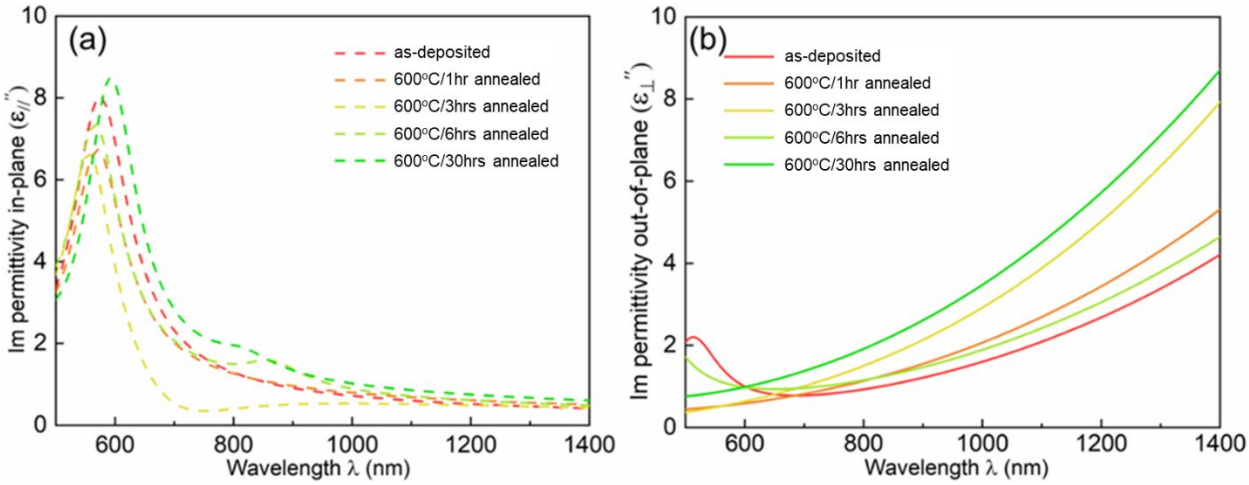


Figure S3. Imaginary part of (a) in-plane $(\varepsilon''_{\parallel})$ and (b) out-of-plane $(\varepsilon''_{\perp})$ permittivity components for the as-deposited and 600°C post-annealed for different time (1, 3, 6, 30 hrs) Au-BTO thin films.

Raman spectroscopy

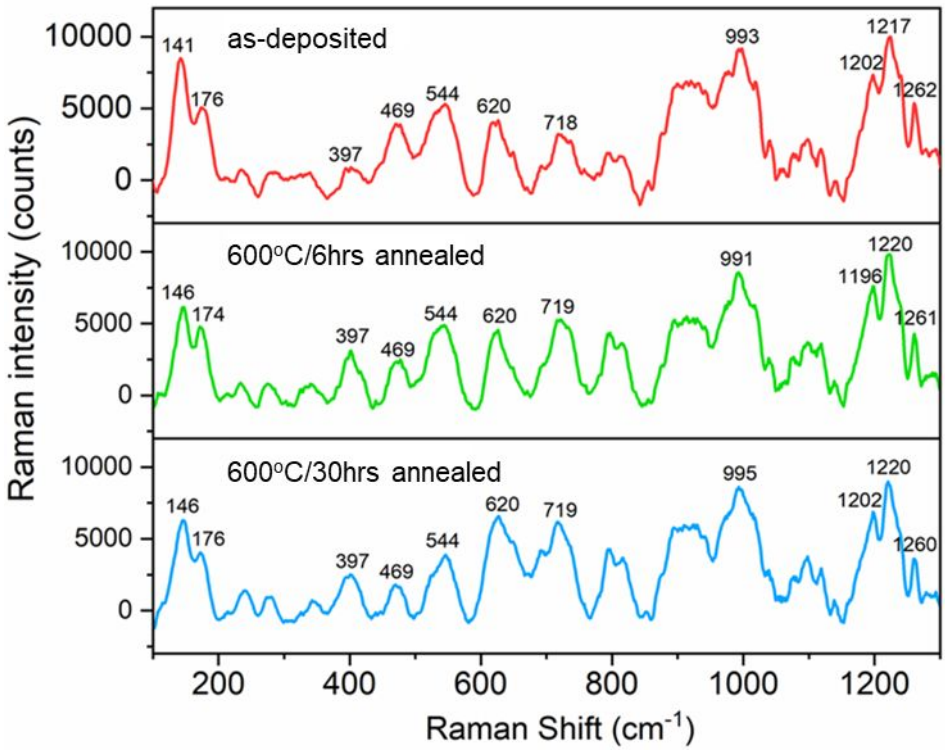


Figure S4. Raman spectra of as-deposited, 600°C/6hrs and 600°C/30hrs annealed Au-BTO nanocomposite thin films.

STEM and EDS mappings of 750°C/1hr annealed Au-BTO hybrid film

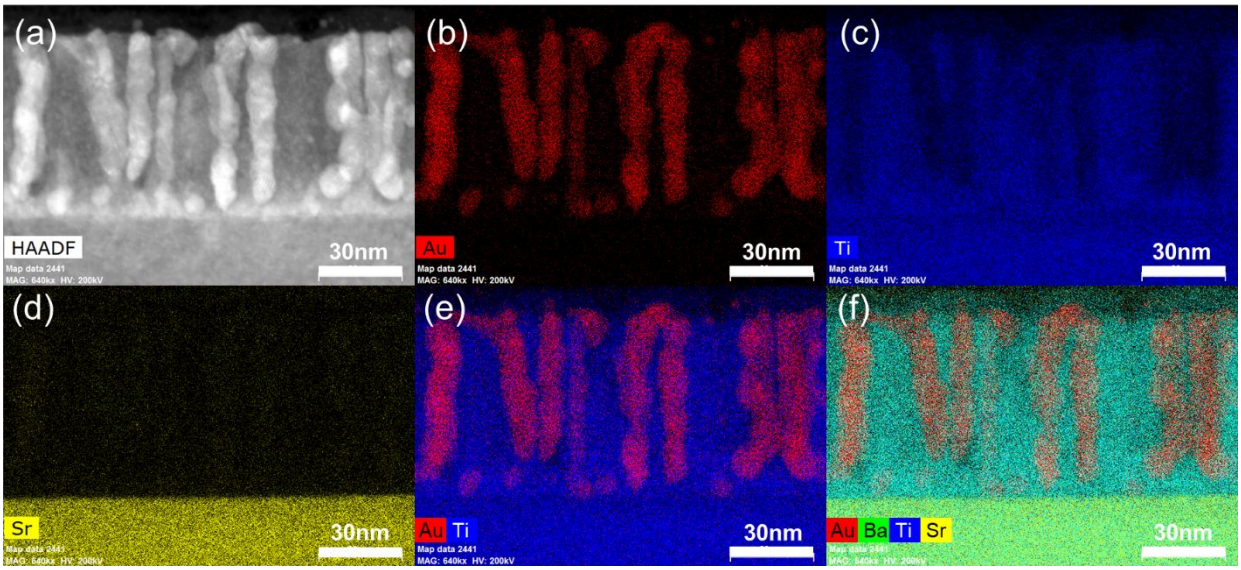


Figure S5. (a) Cross-section STEM-HAADF image and (b-f) corresponding EDS mappings of 750°C/1hr annealed Au-BTO nanocomposite film.

STEM and EDS mappings of 950°C/1hr annealed Au-BTO hybrid film

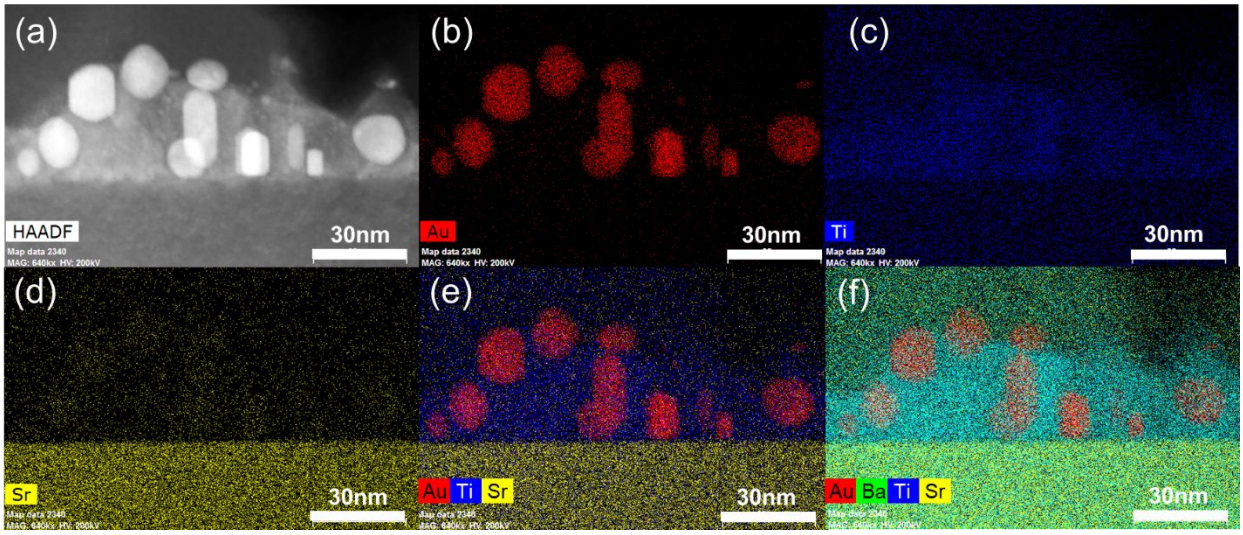


Figure S6. (a) Cross-section STEM-HAADF image and (b-f) corresponding EDS mappings of 950°C/1hr annealed Au-BTO nanocomposite film.

Calculation of Au nanopillar distribution density

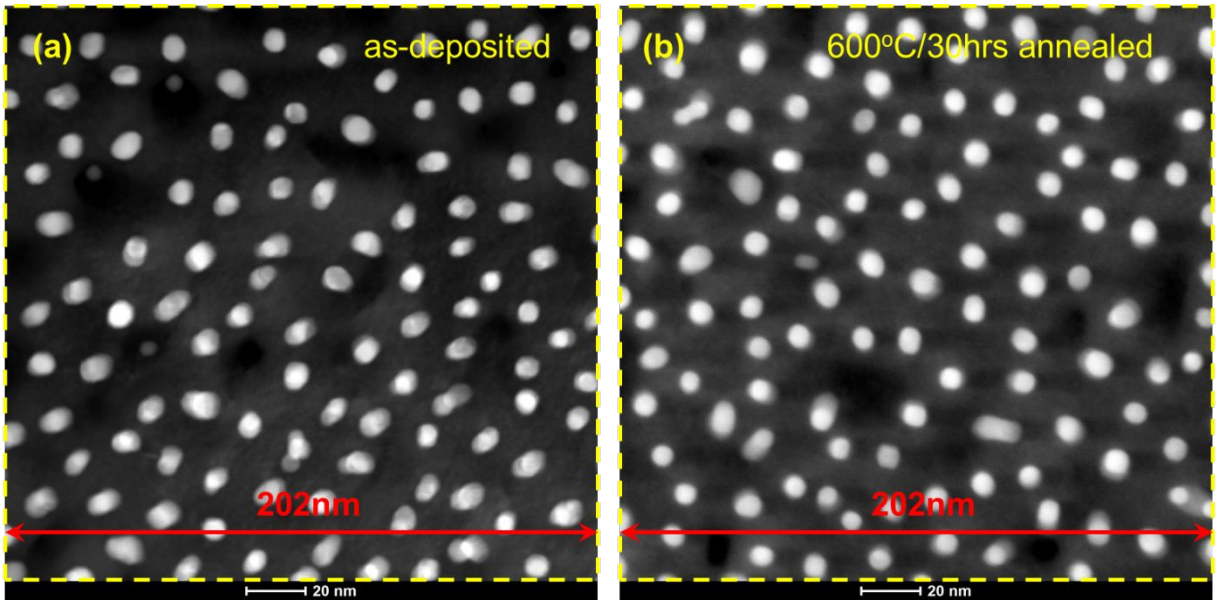


Figure S7. Plan-view STEM images of (a) as-deposited and (b) 600°C/30hrs annealed Au-BTO hybrid thin film.

Number of Au nanopillars in a square area: N

Area of the square: S = a × a

then,

Area density of Au nanopillars: $\rho_s = \frac{N}{S}$

Line density of Au nanopillars: $\rho_l = \sqrt{\frac{N}{S}} = \frac{\sqrt{N}}{a}$

Average distance between two Au pillars: $\bar{d} = 1/\rho_l$

	as-deposited thin film	600°C/30hrs annealed film
Number of Au nanopillars N	102	101
Side of square region a (nm)	202	202
Line density of Au nanopillars ρ_l (1/nm)	0.0499	0.0497
Average spacing between two Au pillars $\bar{d}$ (nm)	20.04	20.14

Selected area diffraction patterns (SADP)

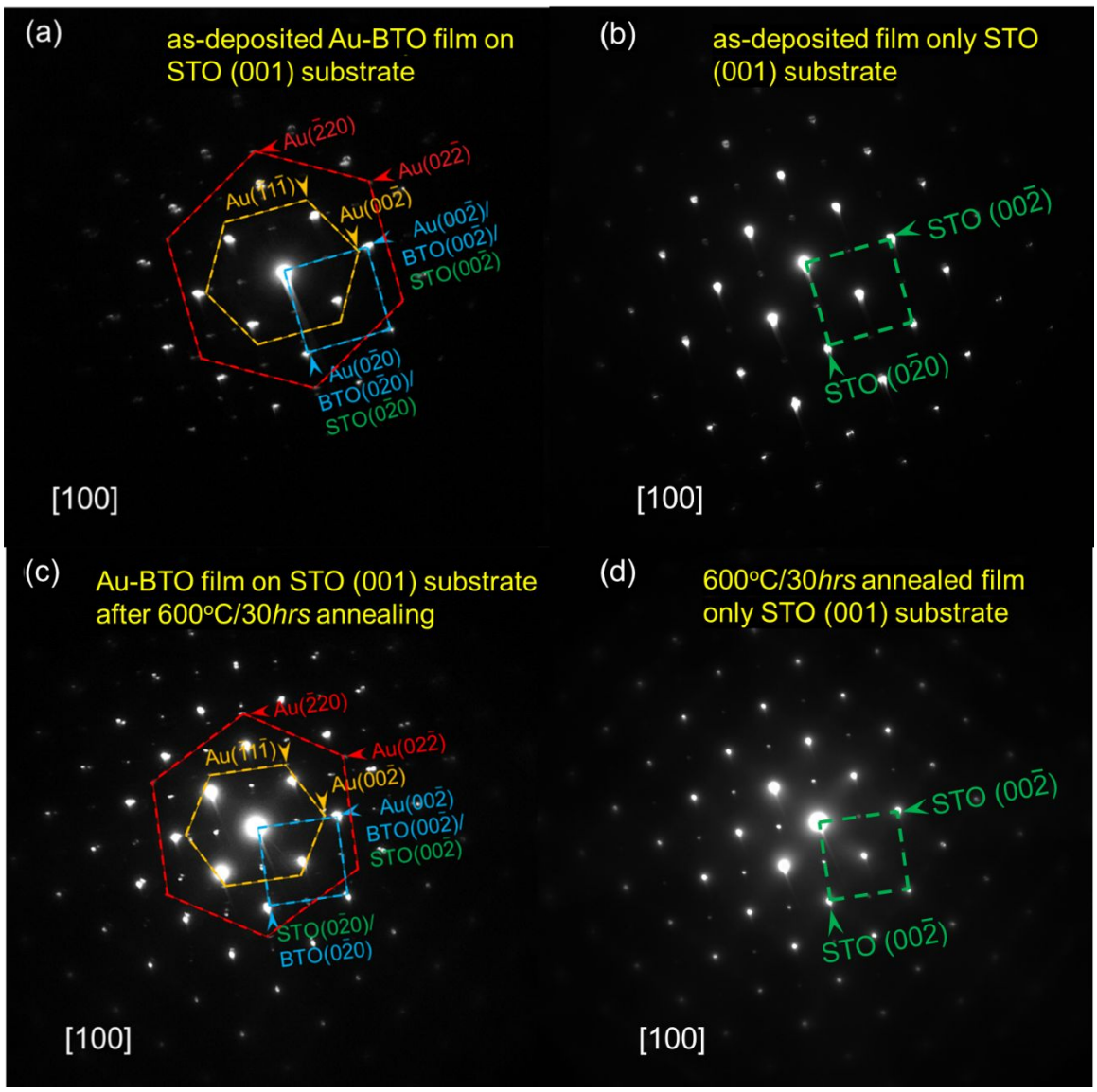


Figure S8. Selected area diffraction patterns (SADP) taken in [100] zone axis of (a) as-deposited Au-BTO hybrid film grown on STO (001) and (b) only STO (001) substrate. (c) 600°C/30hrs annealed Au-BTO films grown on STO (001) and (d) only STO (001) substrate.