Electronic Supplementary Information for

Photo-Assisted Epitaxial Growth from Nanoparticles to Enhance Multi-Materialization for Advanced Surface Functionalization

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Table S1. The optical and thermal parameters for numerical simulations

	R (at 248 nm)	α / cm^{-1}	κ / W cm^{-1} K^{-1}	ρ / g cm^{-3}	C / J g^{-1} K^{-1}
$CaTiO_3$ (CTO)			0.042[1]	4.10[2]	0.721[3]
$BaTiO_3$ (BTO)			0.027[4]	6.06[2]	0.450[5]
$SrTiO_3$ (STO)	0.326[6]	700000[6]	0.11[7]	5.17[2]	0.536[8]
Film (a-1)	0.165	260000	0.04[a]	4.63[a]	0.625[a]
Film (b-2)	0.104	280000	0.04[a]	4.41[a]	0.663[a]

[a]The parameters were determined using the values for CTO and BTO and their respective ratio in each film. The values in the table represent the following properties: R (reflectance), α (optical absorption coefficient), κ (thermal conductivity), ρ (mass density), and C (specific heat capacity). They were substituted into the following heat diffusion equation, which is simplified into one-dimensional heat flow and includes T (temperature), t (time), z (depth), and $I(z, t)$ (laser intensity), $\rho C(\partial T/\partial t) = \kappa(\partial^2 T/\partial z^2) + \alpha I(z, t)$.

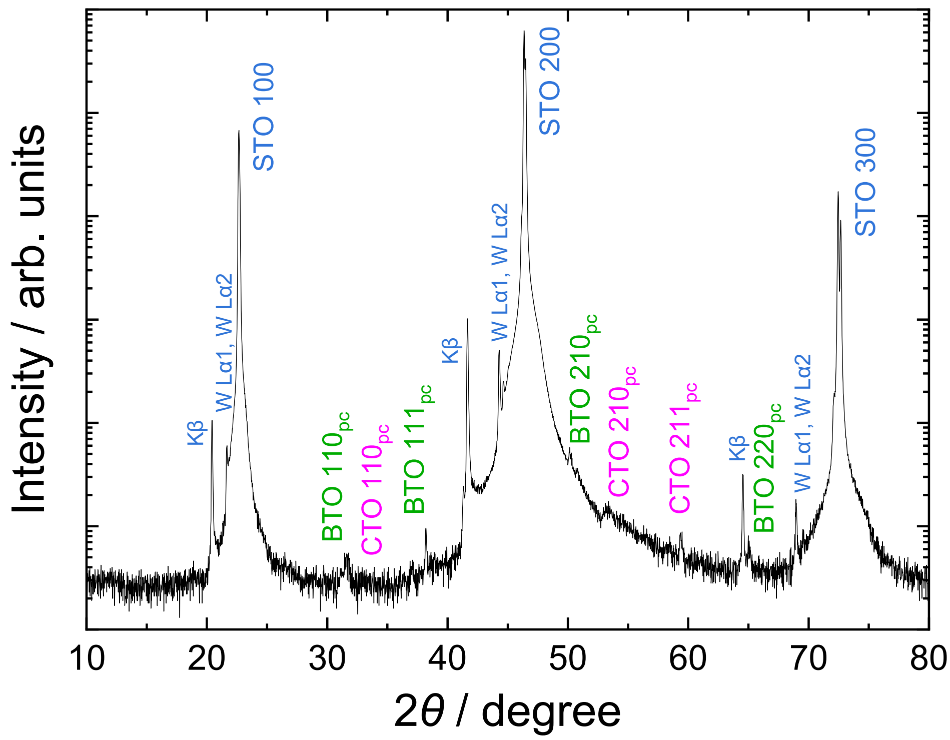

Fig. S1. X-ray diffraction (XRD) pattern (2θ/ω) for film (a-1) with the intense STO peaks derived from the Cu Kβ and W Lα lines hindering the observation of the epitaxial growth of CTO from STO single-crystal (STO_{SC}) substrate.

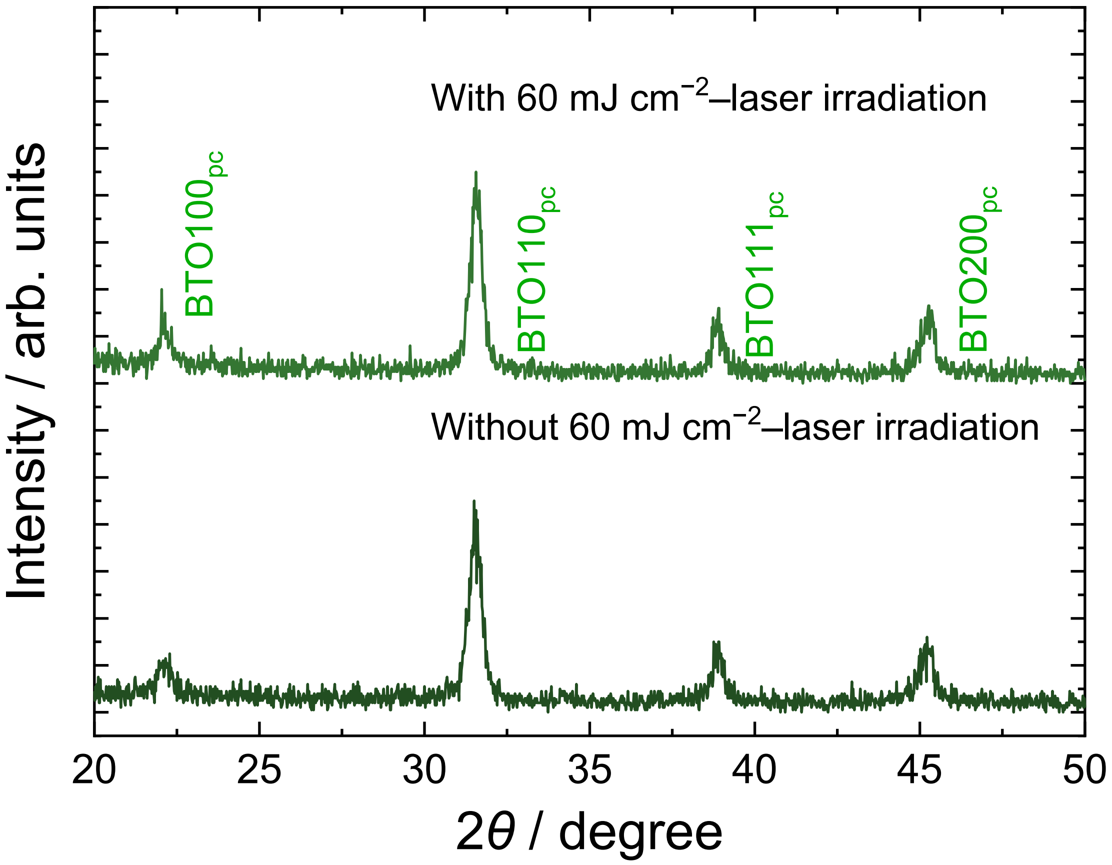

Fig. S2. Grazing incidence X-ray diffraction (ω = 0.5 °) patterns for films on glass coated with BTO nanoparticle (BTO_{NP}) colloidal dispersion with (upper side) and without (lower side) 60 mJ cm^{-2}–laser irradiation, indicating that laser irradiation does not change the peak intensity of BTO_{NP}. The laser irradiation conditions for the two films were set following those for CTO-BTO films (a-1) and (b-1) in the main text: with a KrF pulse laser with a wavelength of 248 nm, pulse duration of 26 ns, and frequency of 50 Hz at 300 °C at 30 mJ cm^{-2} for 500 pulses. Subsequently, only one of the film was irradiated with the laser at the same wavelength, pulse duration, frequency, and temperature conditions with fluence of 60 mJ cm^{-2} for 500 pulses.

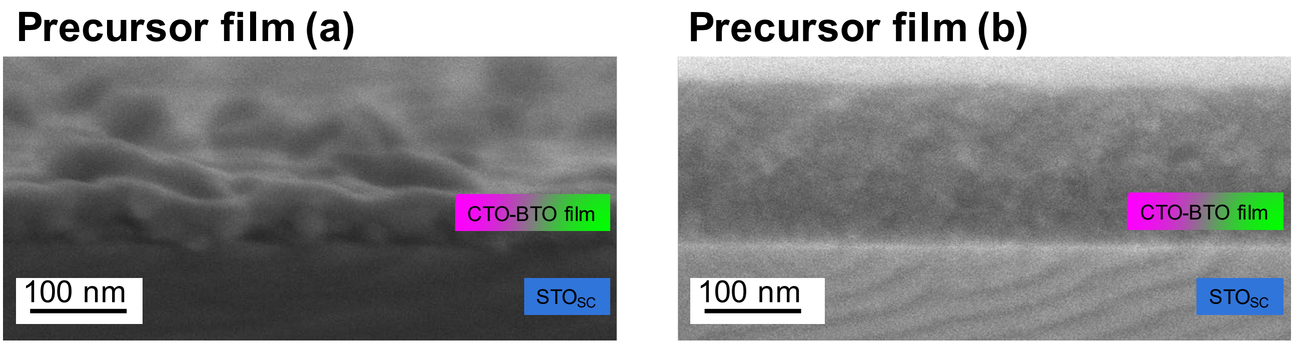

Fig. S3. Cross-sectional scanning electron microscopy images for precursor films (a) and (b).

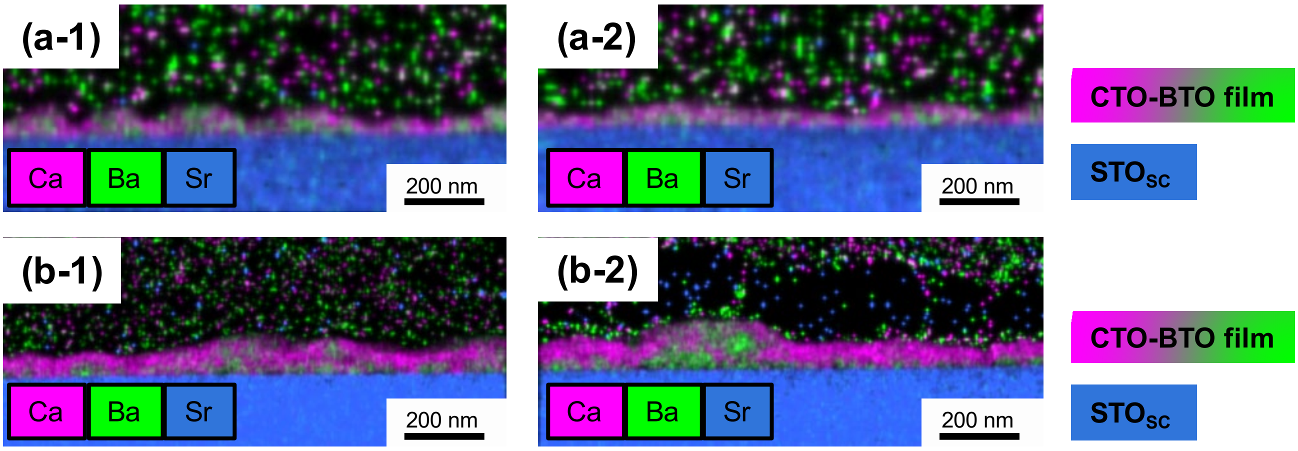

Fig. S4. Energy-dispersive X-ray spectroscopy (EDS) mappings for the CTO-BTO films (a-1), (a-2), (b-1), and (b-2). The magenta, green, and blue colors represent Ca, Ba, and Sr atoms, respectively.

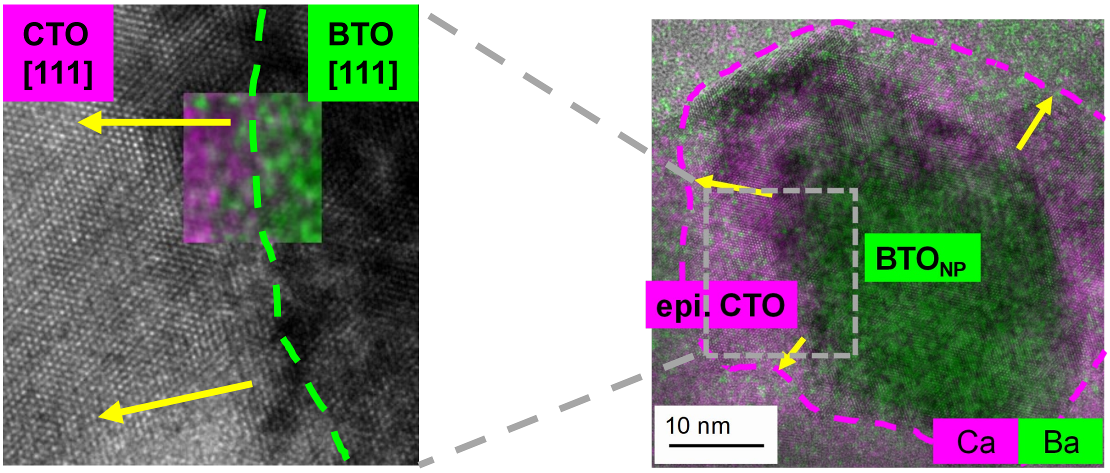

Fig. S5. Enlarged Cross-sectional transmission electron microscopy (X-TEM) image overlaid with the EDS mapping for BTO$_{NP}$ in film (a-1), presented in Fig. 3. The interface between CTO and BTO$_{NP}$ shows a continuous lattice image, highlighting the epitaxial growth of CTO from BTO$_{NP}$.

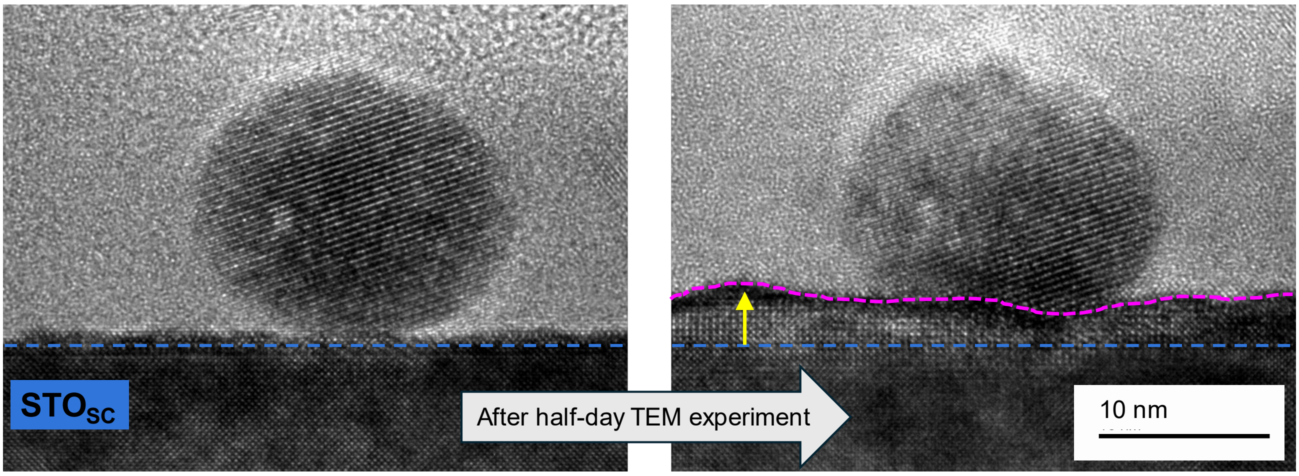

Fig. S6. X-TEM images of electron beam induced crystallization at the STO_{SC} interface in the film (b-1).

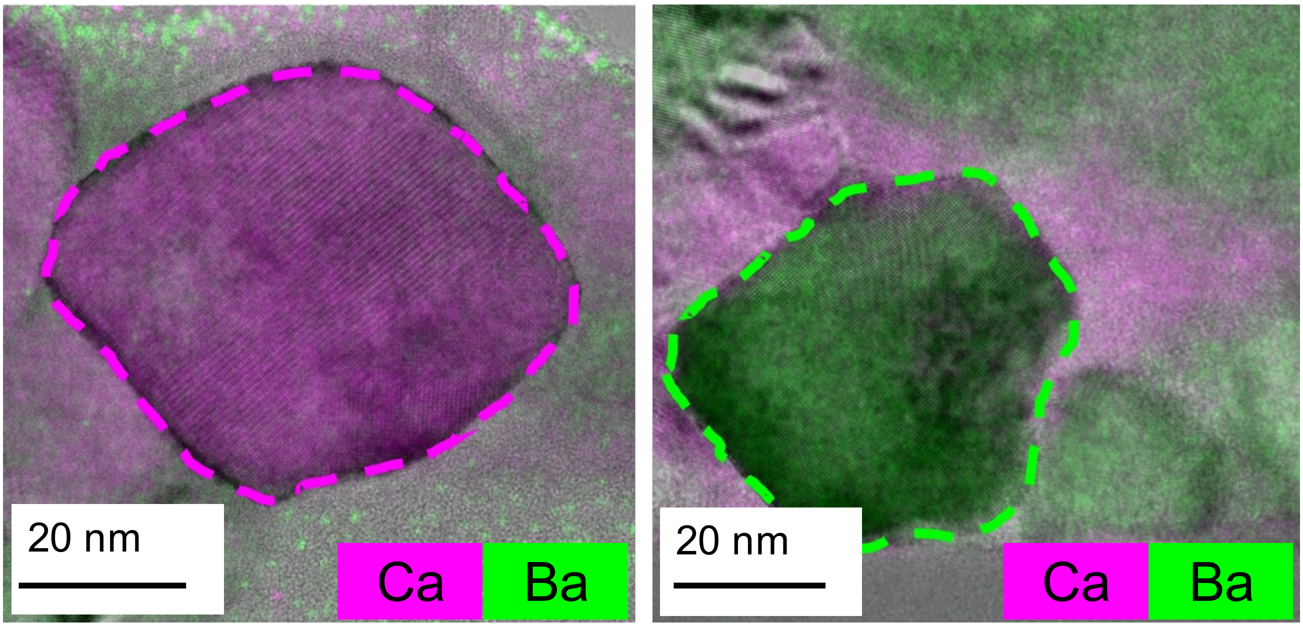

Fig. S7. Enlarged view of X-TEM images for NPs from $[100]_{pc}$ direction in the (b-2) film: (left) CTO_{NP} derived from crystal nucleation growth with partial multi-domain, (right) BTO_{NP} surrounded by CTOs with discontinuous lattice images, indicating no epitaxial growth.

References

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