Supplementary information

Evaluation of nanoparticle distribution in solution-derived $YBa_2Cu_3O_{7-\delta}$ nanocomposite thin films by XPS depth profiling in combination with TEM analysis.

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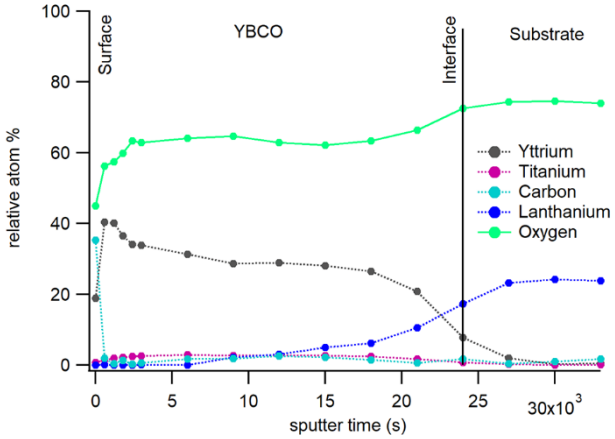

Figure S1: Depth profile of pyrolyzed 15 mol-% $SrTiO_3$-added YBCO nanocomposite film on an $LaAlO_3$ substrate, including the oxygen signal

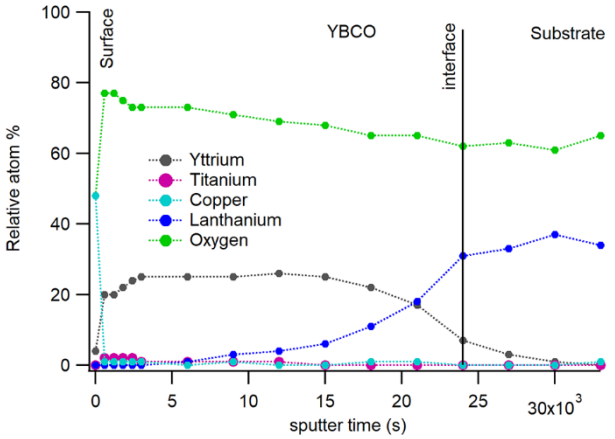

Figure S2: Depth profile of crystallized 10 mol-% $SrTiO_3$-added YBCO nanocomposite film on an $LaAlO_3$ substrate, including the oxygen signal

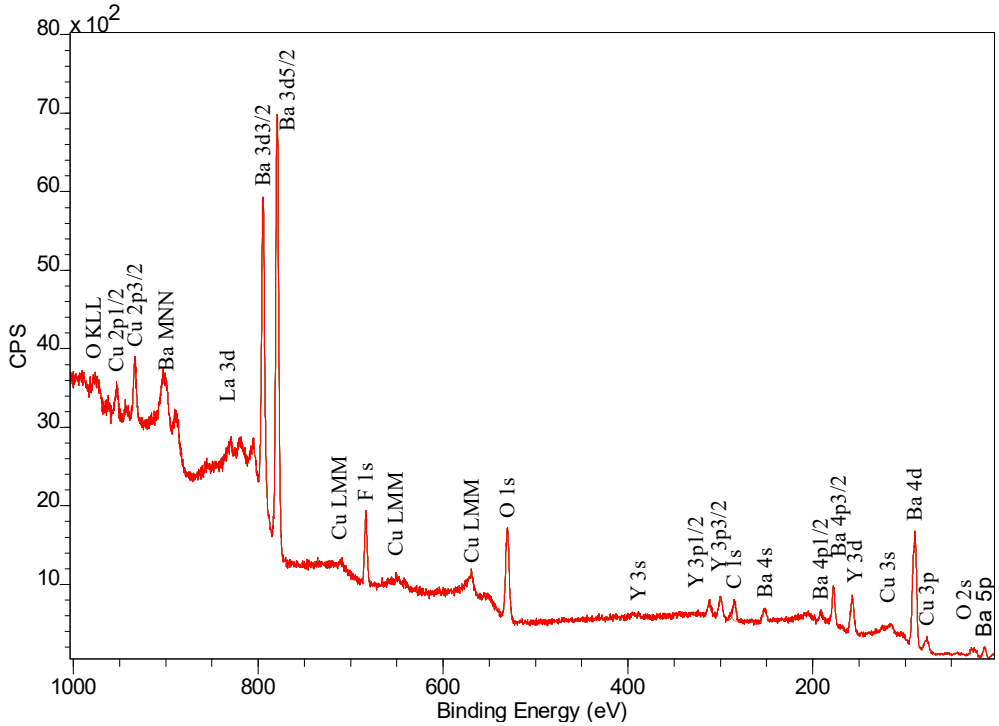

Figure S3: Survey of the surface of a crystallized 10 mol-% ZrO_2-added YBCO nanocomposite film on an $LaAlO_3$ substrate

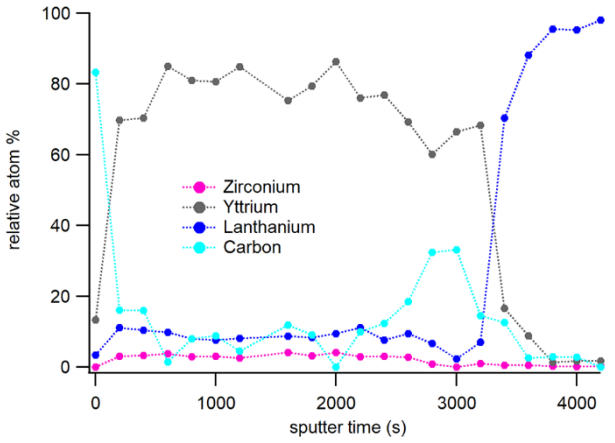

Figure S4: Depth profile of crystallized 10 mol-% ZrO_2-added YBCO nanocomposite film on an $LaAlO_3$ substrate.

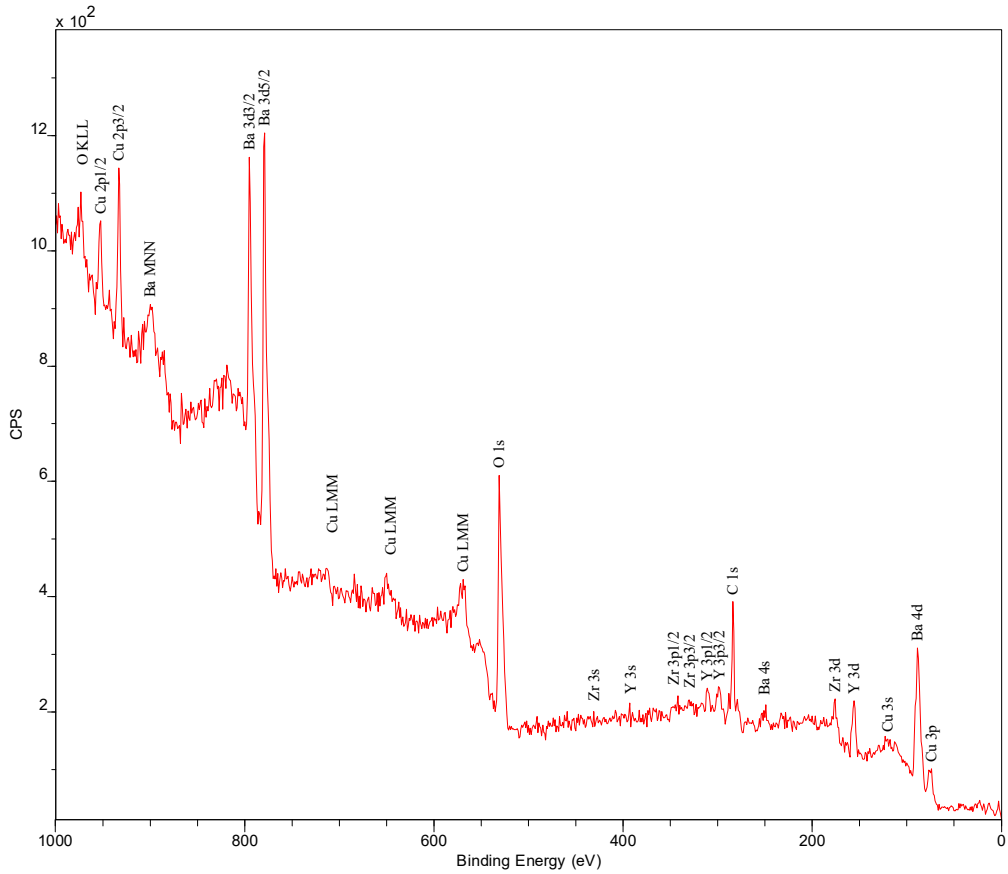

Figure S5: Survey of the surface of crystallized 10 mol-% ZrO_2-added YBCO nanocomposite film on an $LaAlO_3$ substrate

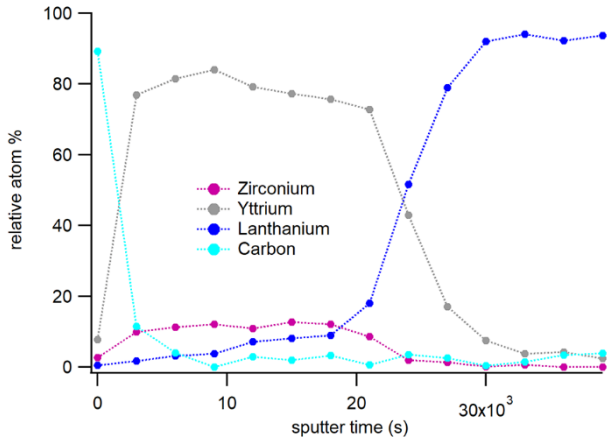

Figure S6: Depth profile of crystallized 10 mol-% ZrO_2-added YBCO nanocomposite film on an $LaAlO_3$ substrate

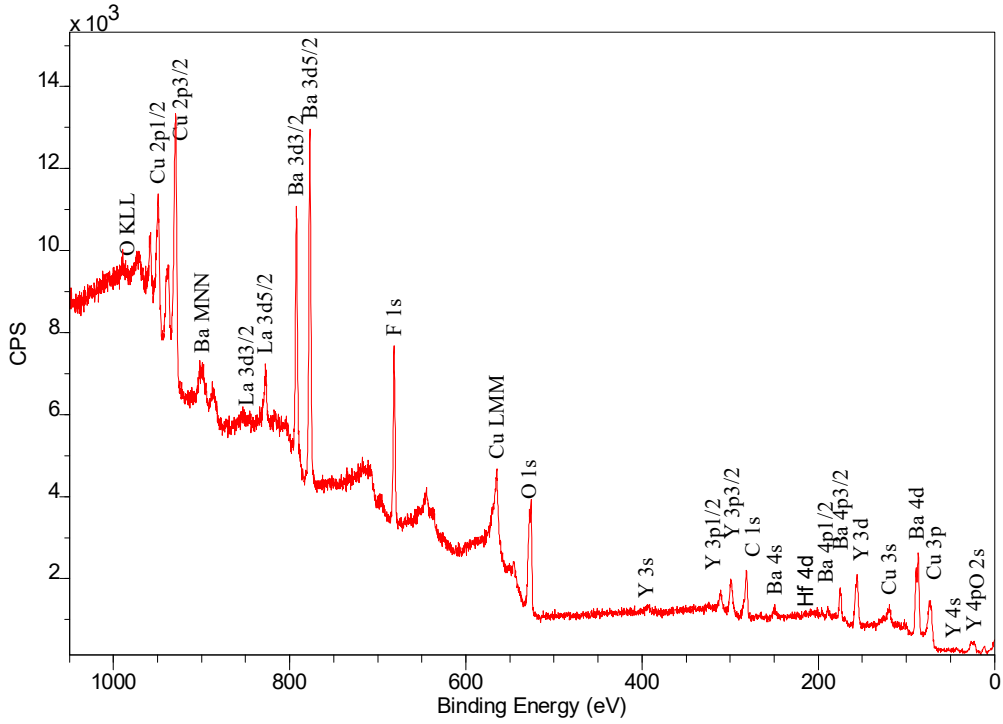

Figure S7: Survey of the surface of pyrolyzed 7.5 mol-% HfO_2-added YBCO nanocomposite film on an $LaAlO_3$ substrate.

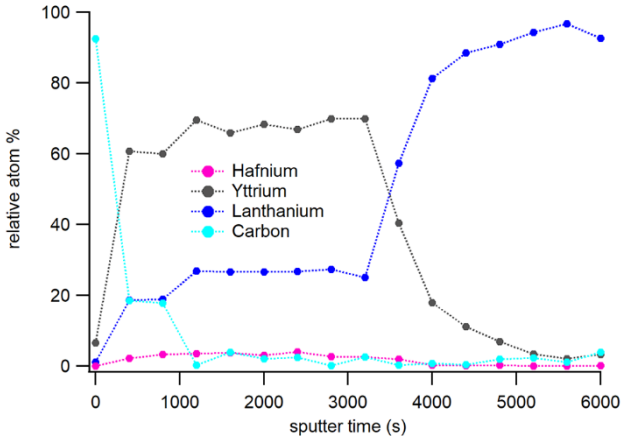

Figure S8: Depth profile of pyrolyzed 7.5mol-% HfO_2-added YBCO nanocomposite film on an $LaAlO_3$ substrate

The superconducting properties of $SrTiO_3$-added YBCO nanocomposite films were measured inductively via THEVA Cryoscan™ with the voltage criterion of 50 µV. It can be concluded that self-field J_c values at 77 K (Table S1) are slightly decreased in relation to an increased volume of $SrTiO_3$ nanoparticles.

Table S1: Critical current density (J_c) of 0, 5, 10 and 15 mol-% $SrTiO_3$-added YBCO films on an $LaAlO_3$ substrate, calculated via inductively measurements.

STO nanoparticles mol-%	**$J_{c,av}$ (0 T, 77 K) MA cm^{-2}**
0	4.4
5	4.1
10	3.9
15	3.6

To investigate the influence of $SrTiO_3$ nanoparticles in the YBCO matrix, YBCO with 0, 5 and 10 mol-% $SrTiO_3$ nanoparticles on $LaAlO_3$ substrates are coated with silver (1 micron) via lithography and laser-cut to nano-bridges of ~15-20 µm width and 800 µm length for the transport measurements via Physical Property Measurement System with E_c = 1 µV cm^{-1}. Figure S9a shows the magnetic field dependence of the critical current density at 77 K and $H//c$ of YBCO film with 0, 5 and 10 mol-% $SrTiO_3$ nanoparticles. Unfortunately, no pinning effect is observable when the magnetic field is increased, which means that $SrTiO_3$ nanoparticles do not act as pinning centers. It is also confirmed via the angular dependency at 77 K and 1 T on Figure S9b where no improvement of the pinning effects is shown.

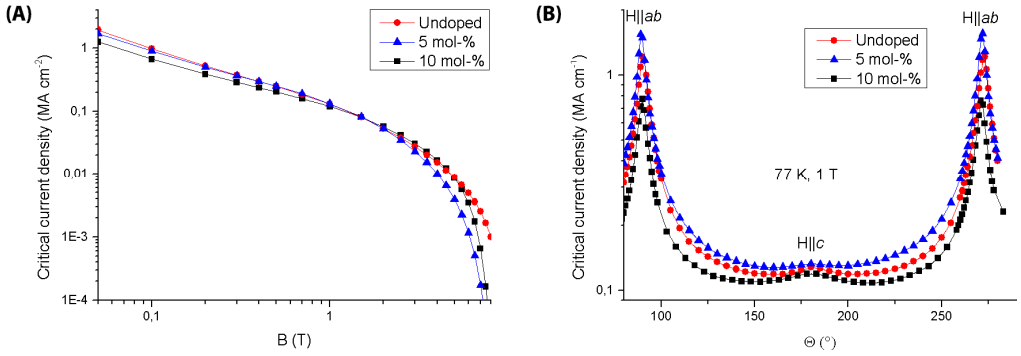

Figure S9: Superconducting properties of 5 and 10 mol-% $SrTiO_3$-added YBCO nanocomposite films compared with an pristine YBCO film: (A) Magnetic field dependence of critical current density at 77 K and (B) angular dependence of J_c at 77 K and 1 T.