Supplementary Information

Ferromagnetism with strong magnetocrystalline anisotropy in *A*-site ordered perovskite $YBaCo_2O_6$ epitaxial thin film prepared via wet-chemical topotactic oxidation

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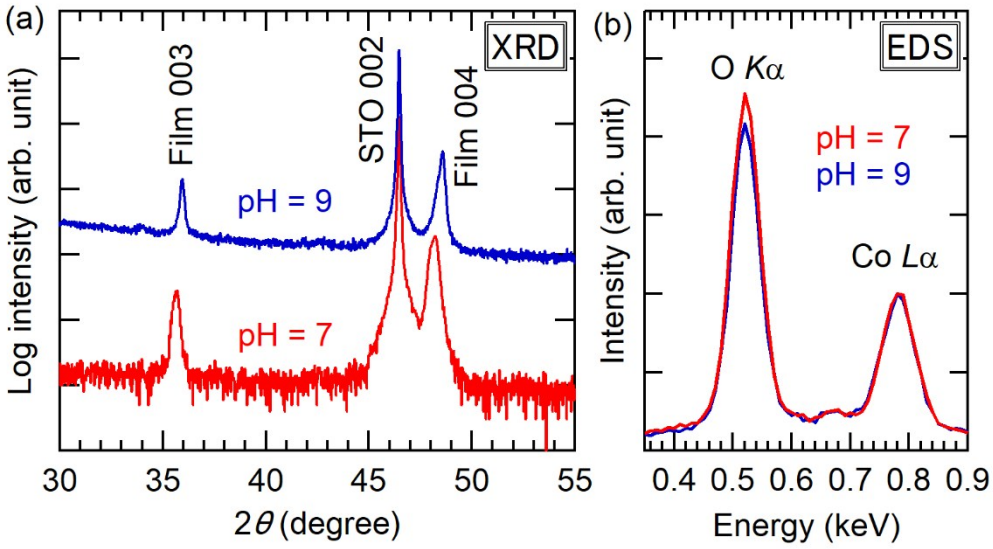

Figure S1. (a) 2θ–θ XRD patterns and (b) EDS spectra of the NaClO-treated $YBaCo_2O_x$ film with pH-7 and 9 NaClO solution at 80 °C for 40 h. The x value reaches 6.0 when reacting with the NaClO solution with a pH of 7 at 80 °C for 40 h, while x is smaller than 5.7 when pH = 9, reacting at 80 °C for 40 h.

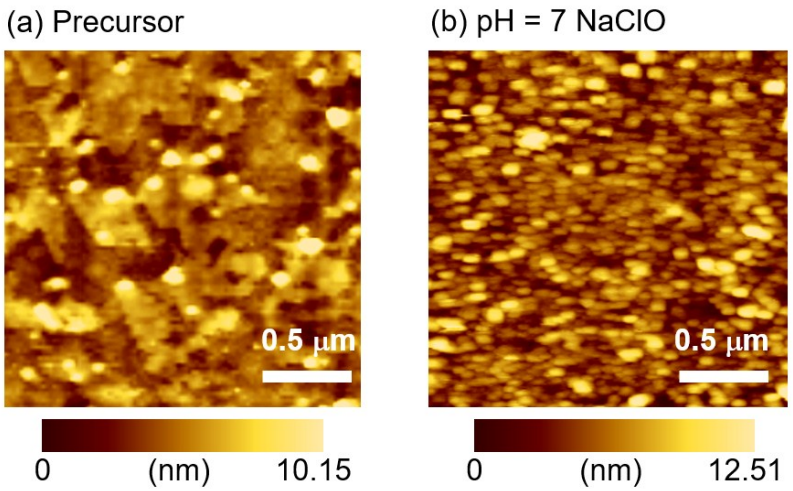

Figure S2. AFM images for the (a) precursor and (b) oxidized films. The oxidized film is prepared with pH-7 NaClO solution at 80 °C for 40 h. The root-mean-square of surface roughness for the oxidized film (2.1 nm) is somewhat larger than that for the precursor film (1.6 nm), showing that the surface morphology became rougher through the oxidation process.

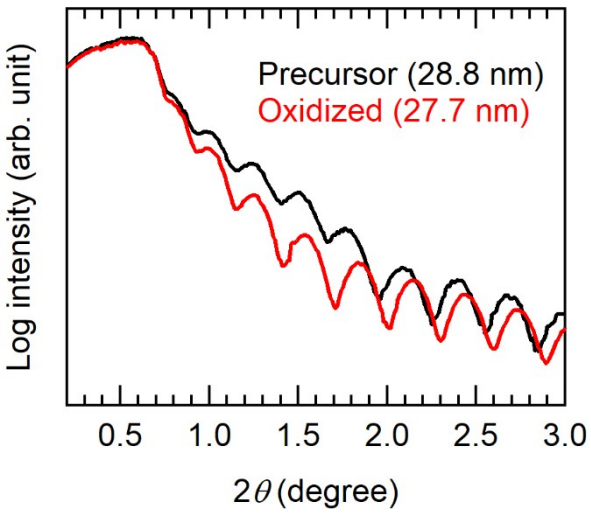

Figure S3. XRR profiles of the precursor $YBaCo_2O_{5.3}$ and oxidized $YBaCo_2O_6$ films. The thickness of the oxidized film is 27.7 nm, which is shorter than that of the precursor film (28.8 nm).

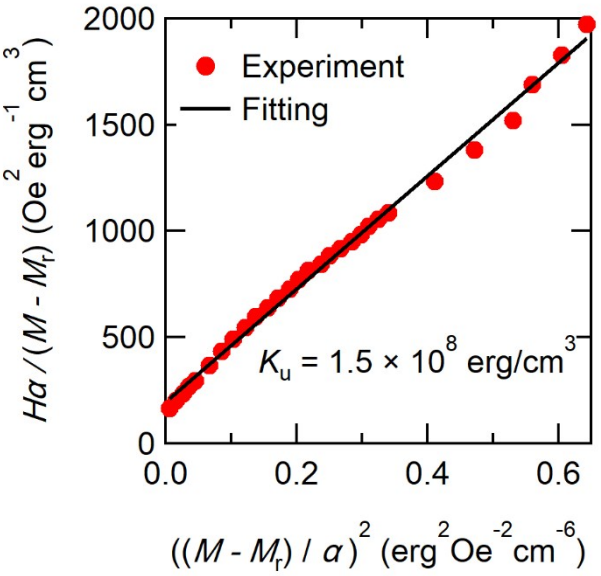

Figure S4. $H\alpha/(M - M_r)$ plotted against $((M - M_r)/\alpha)^2$ for the $YBaCo_2O_6$ film at 5 K under H along [001] direction. The dots represent the experimental data and the solid line is the result of the curve-fitting.

The K_u of the $YBaCo_2O_6$ film at 5 K was evaluated using the modified Sucksmith−Thompson method,[38,39] in which K_u is expressed as the sum of K_1 and K_2 given by the following equation:

$$\frac{H\alpha}{(M - M_r)} = \frac{2K_1}{{M_s}^2} + \frac{4K_2(M - M_r)^2}{\alpha^2 {M_s}^4}$$

where α is $(M_s - M_r) / M_s$, H is the magnetic field, M is the magnetization of the sample measured by applying H perpendicular to the easy axis of magnetization, M_r is the remanent magnetization, and M_s is the saturation magnetization. In the plot, the slope and intercept represent $2K_1/M_s^2$ and $4K_2/M_s^4$, respectively. From the plot, K_u at 5 K of the $YBaCo_2O_6$ film was evaluated to be 1.5×10^8 erg/cm^3.

References

38. U. S. Ram and P. Gaunt, *J. Appl. Phys.*, 1983, **54**, 2872–2874.

39. S. Okamoto, N. Kikuchi, O. Kitakami, T. Miyazaki, Y. Shimada and K. Fukamichi, *Phys. Rev. B*, 2002, **66**, 024413.