Electronic Supplementary Information (ESI)

Rocksalt-type heavy rare earth monoxides TbO, DyO, and ErO exhibiting the metallic electronic states and ferromagnetism

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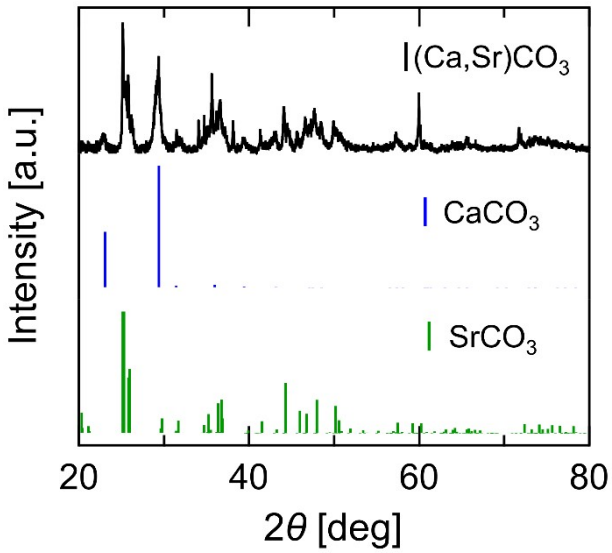

Fig. S1 XRD θ–2θ pattern of spark plasma sintered $(Ca_{0.5}Sr_{0.5})CO_3$ target with the powder XRD pattern of $CaCO_3$ (space group: R-3cH, ICSD No. 18164) and $SrCO_3$ (space group: Pmcn, ICSD No.15195) calculated by VESTA.[1] Mixture of $CaCO_3$ and $SrCO_3$ powder with the molar ratio of 1:1 was pressed, and then sintered at 1200 °C under 50 MPa for 30 minutes.

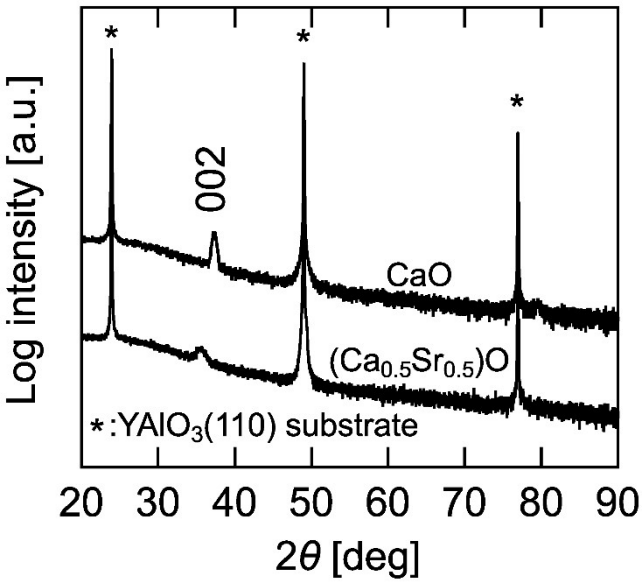

Fig. S2 XRD θ–2θ patterns of $(Ca_{0.5}Sr_{0.5})O$ and CaO thin films with the same thickness as those of buffer layers for the *RE*O thin films in Table 1.

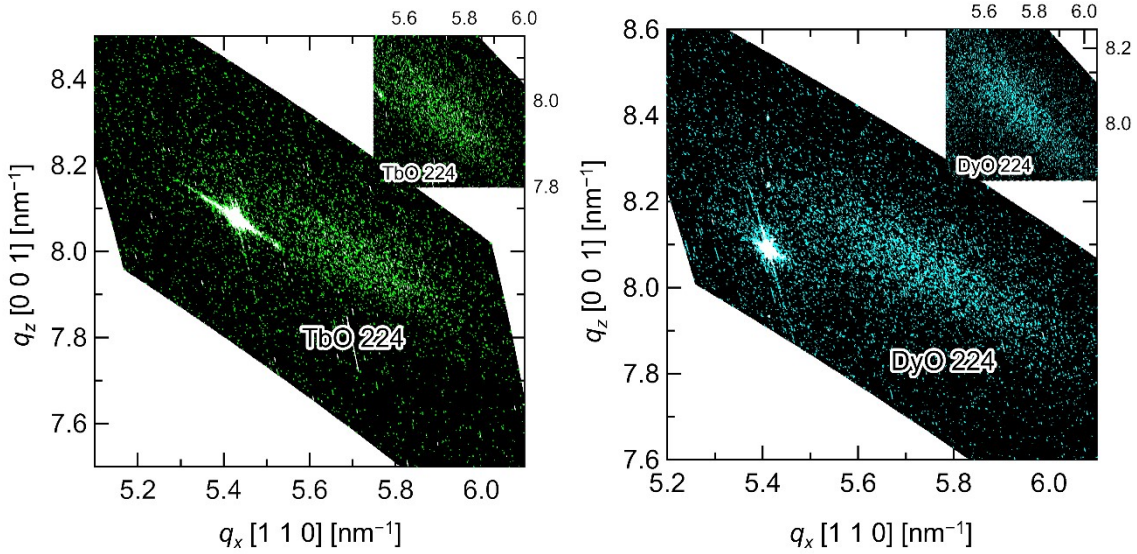

Fig. S3 Reciprocal space maps for TbO (left) and DyO (right) thin films around the *RE*O 224 and $YAlO_3$ 334 diffraction peaks. Insets show the magnified images around *RE*O 224 peaks.

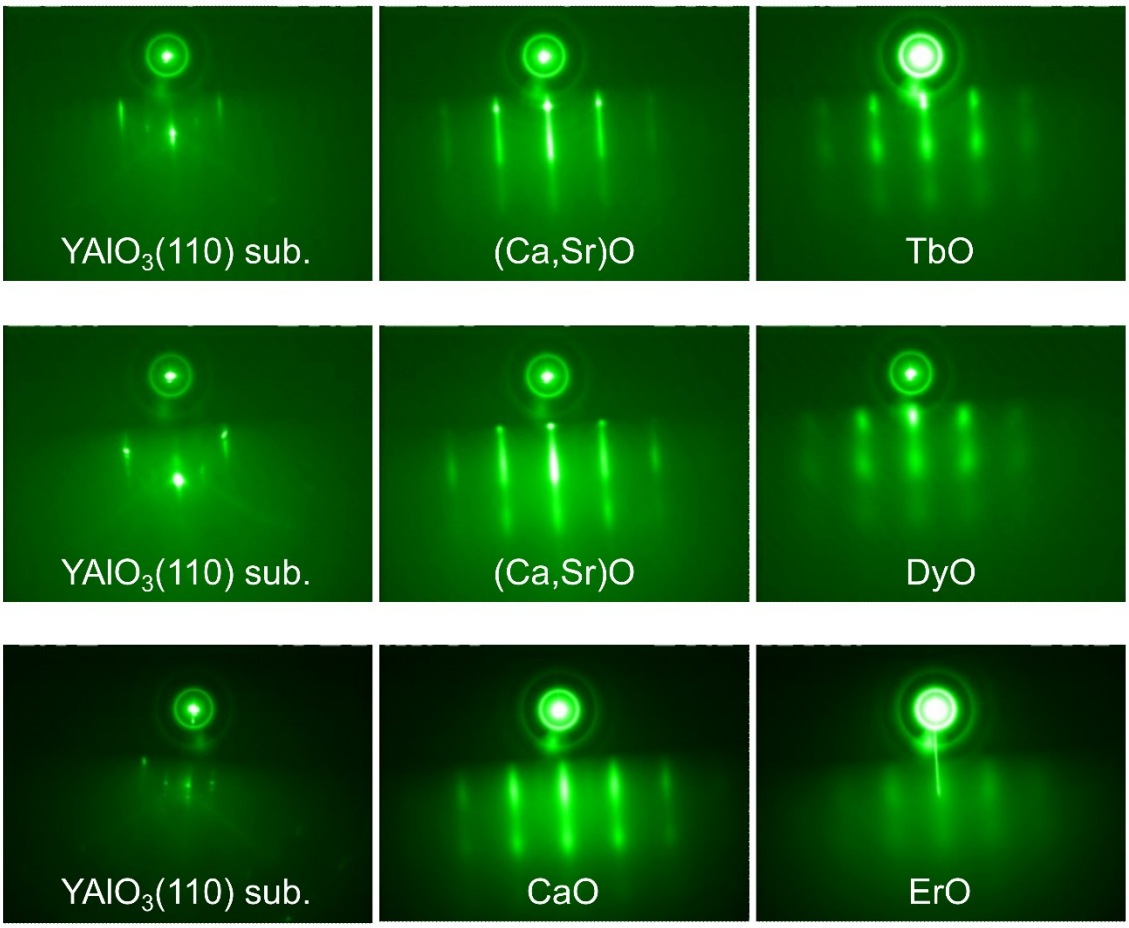

Fig. S4 *In-situ* RHEED patterns of $YAlO_3$ substrates, (Ca,Sr)O and CaO buffer layers, and TbO, DyO, and ErO thin films along [010] during the deposition (see Fig. 1).

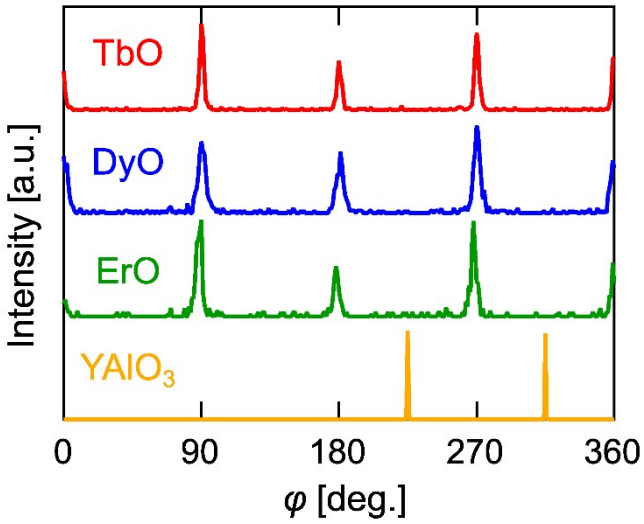

Fig. S5 φ scans taken for TbO (111), DyO (111), ErO (111), and $YAlO_3$ (101) peaks.

Table S1 The $3d_{5/2}$ binding energy (in the unit of eV) of Tb and Dy metals, monoxides and sesquioxides.[2–4]

RE element	*RE* metal	*RE*O	RE_2O_3
Tb	1239.4	1240.4	1241.2
Dy	1293.3	1295.3	1296.5

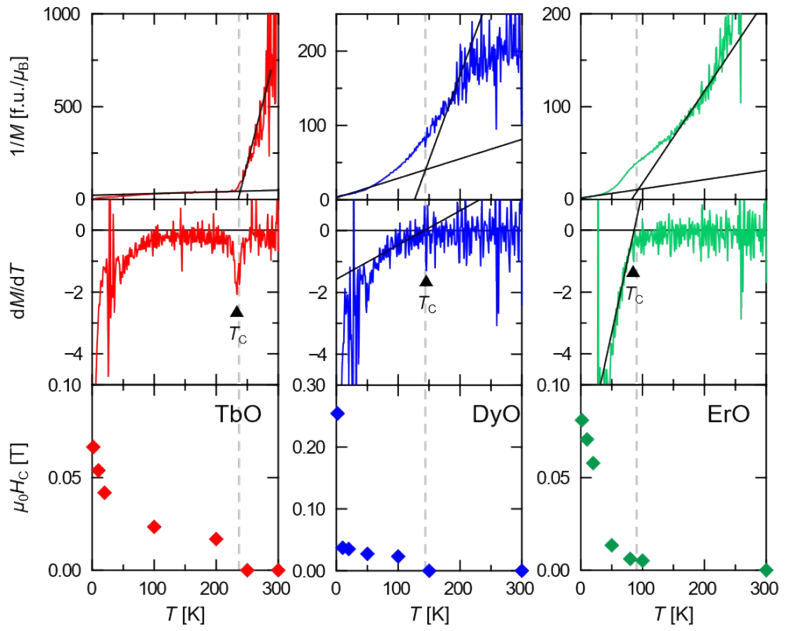

Fig. S6 Temperature dependences of (top panels) M^{-1}, (middle panels) dM/dT under field-cooling at 0.1 T along in-plane from red curves in Fig. 4a–c, and (bottom panels) coercive force (H_c) evaluated from magnetic hysteresis loops in Fig. 4d–f for the *RE*O thin films. The T_C was evaluated as the local minimum of dM/dT for TbO and the onset of dM/dT for DyO and ErO, being consistent with crossing points of linear extrapolation curves (black curves) in M^{-1}–T curves.

References

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