Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supplementary Information

High electrical conduction of Sb square net in anti-$ThCr_2Si_2$ type La_2O_2Sb thin film grown by multilayer solid-phase epitaxy

Yuki Yamamoto,[a] Hideyuki Kawasoko,[a] and Tomoteru Fukumura*[a,b]

[a] *Department of Chemistry, Graduate School of Science, Tohoku University, Sendai 980-8578, Japan*

[b] *Advanced Institute for Materials Research and Core Research Cluster, Tohoku University, Sendai 980-8577, Japan*

* tomoteru.fukumura.e4@tohoku.ac.jp

Table S1 Summary of growth condition, chemical composition, crystal structure parameters, and the correspondence with figures for the La_2O_2Sb epitaxial thin films.

Sample	Multilayer precursor (nominal composition)	T_g	Heating time	Sb/La molar ratio	*a*-axis length (Å)	*c*-axis length (Å)	FWHM of RC (deg)	Figures
A	$[La_2O_3$ (5.1 nm)/La (19 nm)/La_2O_3 (5.1 nm)/Sb (27 nm)$]_2$ ($La_2O_{1.3}Sb_{1.1}$)	650 ºC	11 min	0.44	-	-	-	Fig. 2a, 3, S3
B		750 ºC		0.45	4.099	13.84	1.73	Fig. 2a, 3, S3
C		850 ºC		0.42	4.097	13.91	0.33	Fig. 2a, 3, 6, S1b, S1c, S1d, S2b, S3, S5, S6
D				0.44	4.080	13.94	0.17	Fig. S1c, S2b, S3, S4, S5, S6
E	$[La_2O_3$ (5.5 nm)/La (18 nm)/La_2O_3 (5.5 nm)/Sb (27 nm)$]_2$ ($La_2O_{1.4}Sb_{1.1}$)			0.45	4.067	13.94	0.35	Fig. 2b, 2c, 5, S1b, S4
F	$[La_2O_3$ (6.2 nm)/La (16 nm)/La_2O_3 (6.2 nm)/Sb (27 nm)$]_2$ ($La_2O_{1.5}Sb_{1.1}$)			0.44	4.078	13.95	0.17	Fig. S1a, S1b, S1c, S5, S6
G			30 sec	0.35	-	-		Fig. S1a, S1c
H			60 min	0.36	4.084	13.84	0.16	Fig. S1a, S1c
I	$[La_2O_3$ (5.1 nm)/La (19 nm)/La_2O_3 (5.1 nm)/Sb (27 nm)$]_2$ ($La_2O_{1.3}Sb_{1.1}$)	950 ºC	11 min	0.40	4.078	13.89	0.13	Fig. 2a, 3, 4, 6, S2a, S3, S5
J				0.26	4.084	13.87	0.37	Fig. S2a, S3
K	$[La_2O_3$ (5.1 nm)/La (19 nm)/La_2O_3 (5.1 nm)/Sb (27 nm)$]_2$ ($La_2O_{1.3}Sb_{1.1}$)	1050 ºC		0.00	-	-	-	Fig. 2a, 3, S3

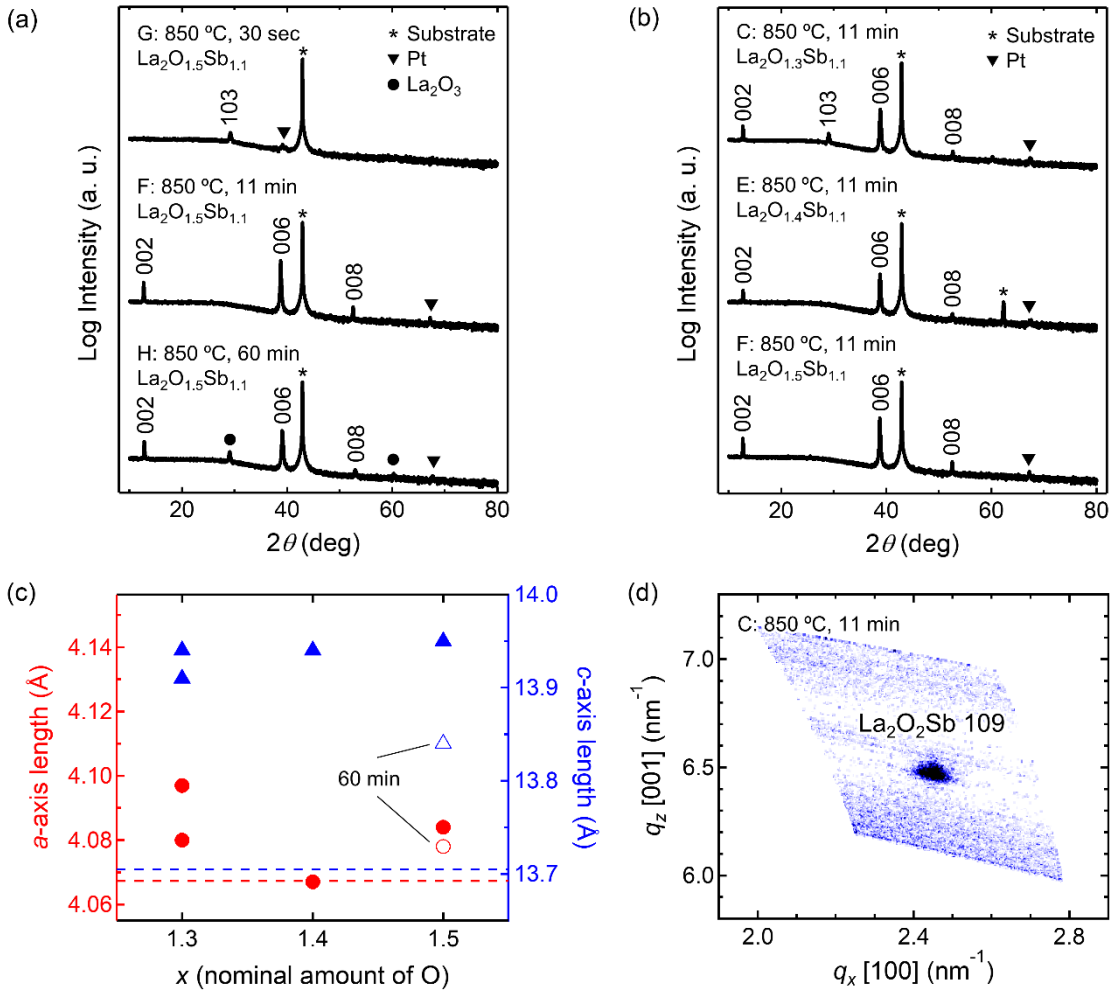

Fig. S1 Out-of-plane XRD patterns of the films on MgO (001) substrates for different (a) heating time (30 sec, 11 and 60 min) and (b) nominal amount of oxygen with T_g = 850 °C. The chemical formulae denote the nominal composition. (c) The *a*- (circle) and *c*- axis lengths (triangle) as a function of nominal amount of oxygen. Red and blue dashed lines represent *a*- and *c*- axis lengths of La_2O_2Sb bulk polycrystal, respectively.[S1] (d) Reciprocal space mapping of the La_2O_2Sb epitaxial thin film with T_g = 850 °C.

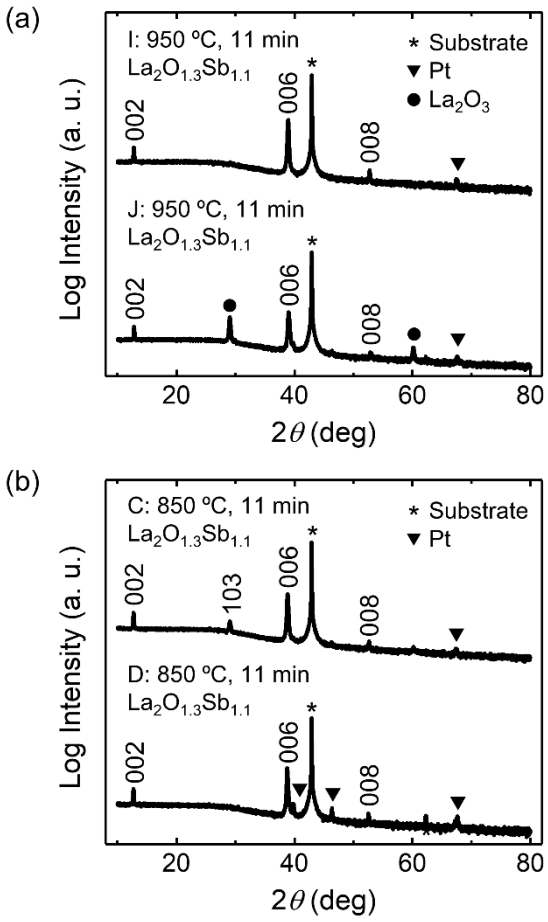

Fig. S2 Out-of-plane XRD patterns of the obtained films on MgO (001) substrates with (a) T_g = 950 °C and (b) 850 °C for two different runs.

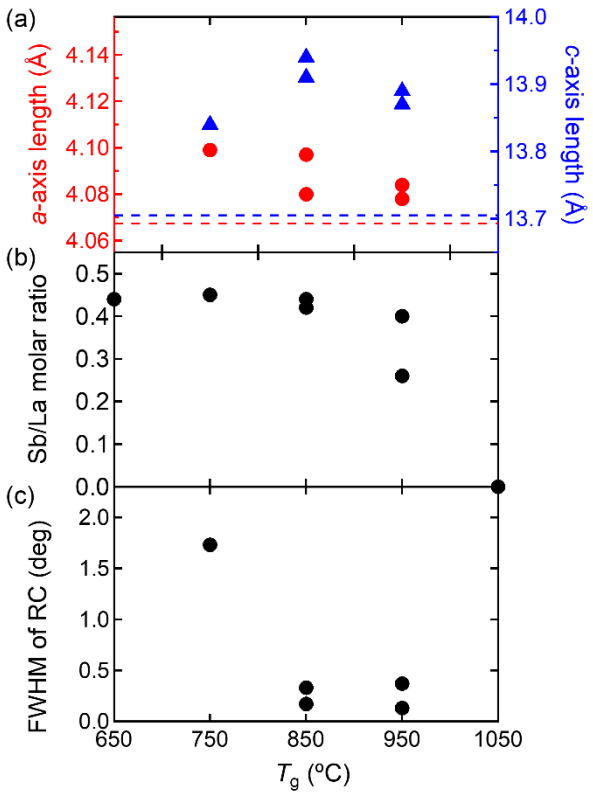

Fig. S3 Growth temperature (T_g) dependence of (a) *a*- (circle) and *c*- axis lengths (triangle), (b) Sb/La molar ratio, and (c) FWHM of rocking curve (RC) for 006 diffraction peak of the La_2O_2Sb epitaxial thin films. Red and blue dashed lines in (a) denote *a*- and *c*- axis lengths of La_2O_2Sb bulk polycrystal, respectively.

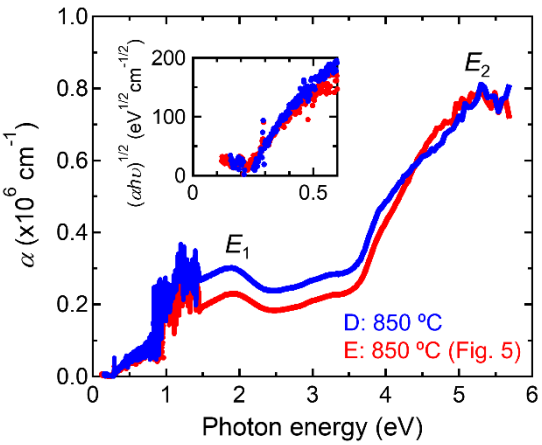

Fig. S4 Absorption coefficient spectra for two different La_2O_2Sb epitaxial thin films with T_g = 850 °C.

Upper inset shows Tauc plot of the absorption edge.

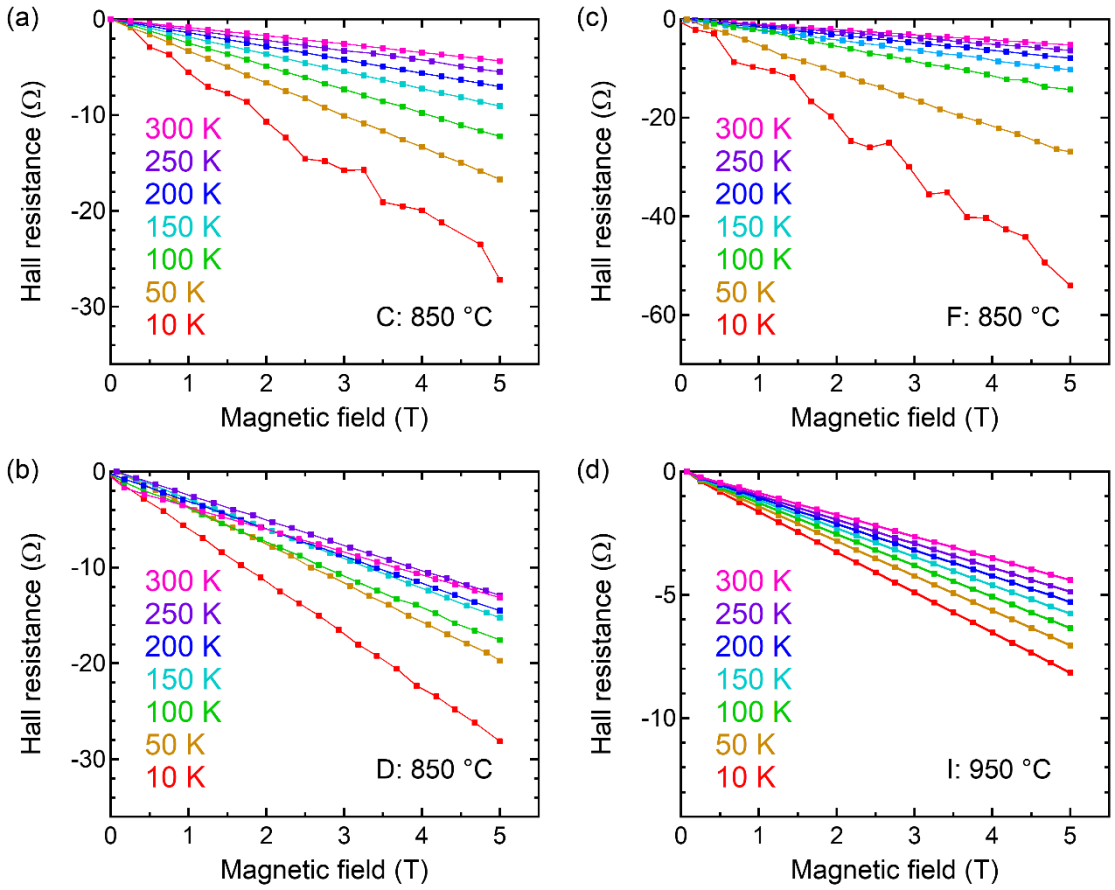

Fig. S5 Magnetic field dependence of Hall resistance for the La_2O_2Sb epitaxial thin films with (a)–(c) T_g = 850 ºC and (d) 950 ºC. The data scattering in the Hall resistance at 10 K in (a) and (c) was caused by the measurement limit due to the high resistance of the films.

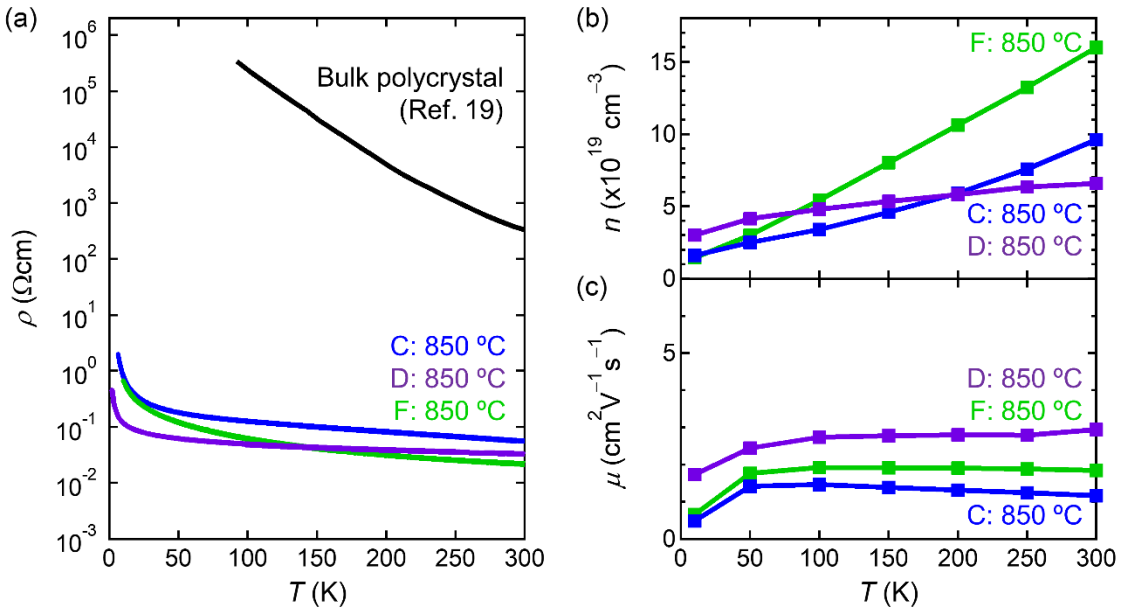

Fig. S6 Temperature dependence of (a) resistivity, (b) carrier density, and (c) carrier mobility for the La_2O_2Sb epitaxial thin films with T_g = 850 °C.

References in supplementary information

S1. P. L. Wang, T. Kolodiazhnyi, J. Yao, Y. Mozharivskyj, *J. Am. Chem. Soc.* 2012, **134**, 1426.