

Supplementary information

Ambient Pressure Synthesis, Structure and Magnetic Properties of a New *A*- and *B*-Site Ordered Multinary Quadruple Perovskite

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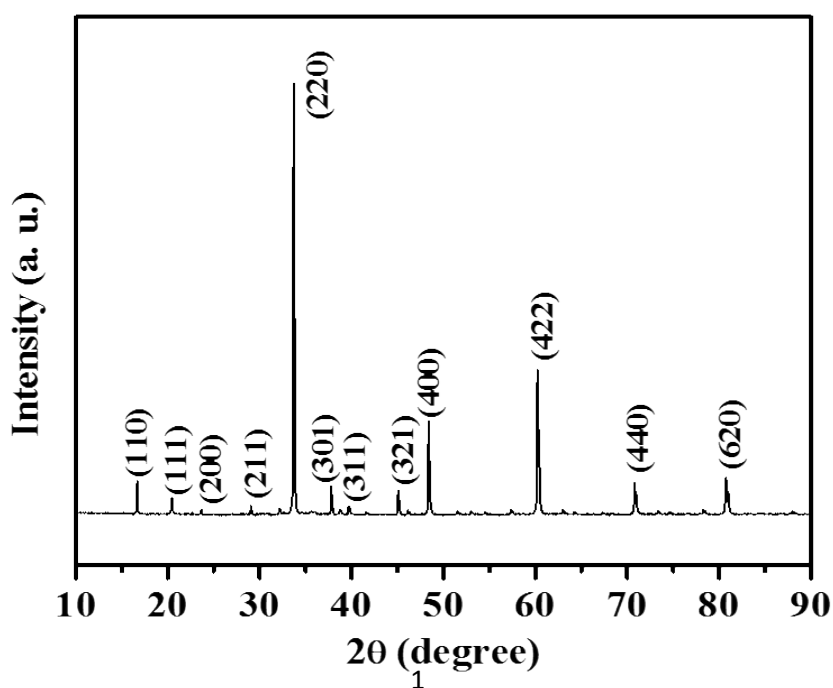


Fig. S1 P-XRD data of $\text{LaCu}_3\text{Fe}_2\text{RuSbO}_{12}$.

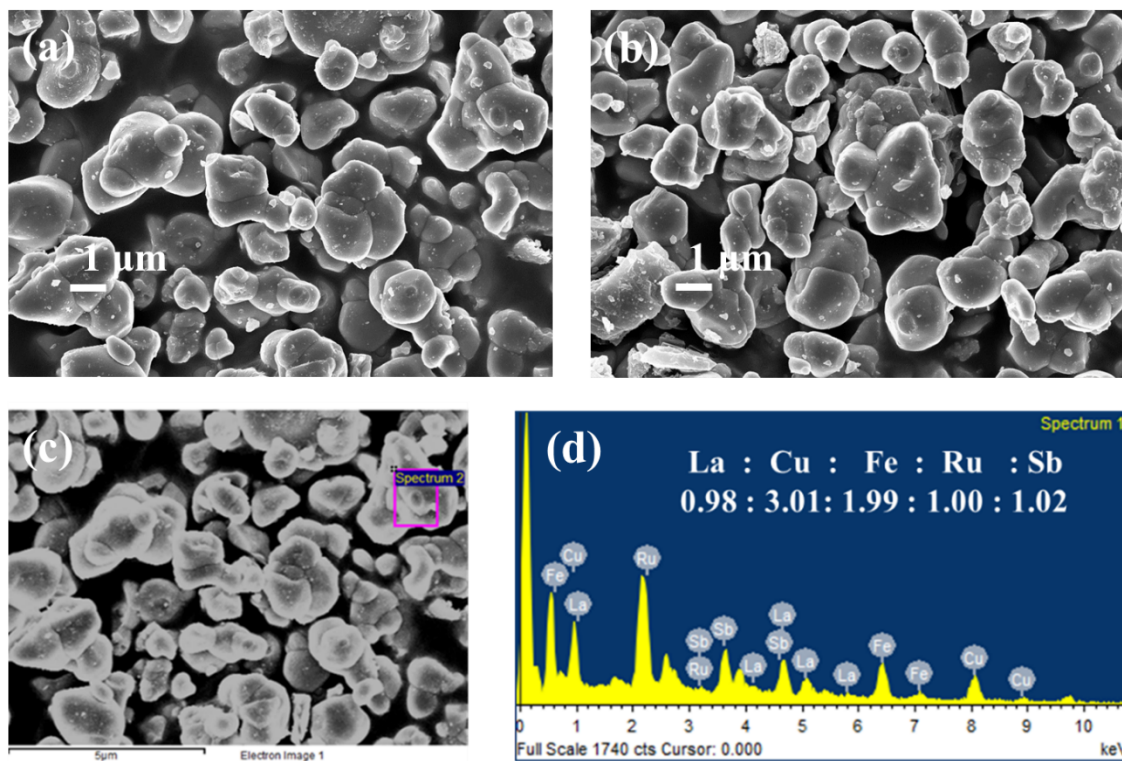


Fig. S2 (a, b) FE-SEM images, (c) image showing EDS analysis region and (d) EDS data of $\text{LaCu}_3\text{Fe}_2\text{RuSbO}_{12}$.

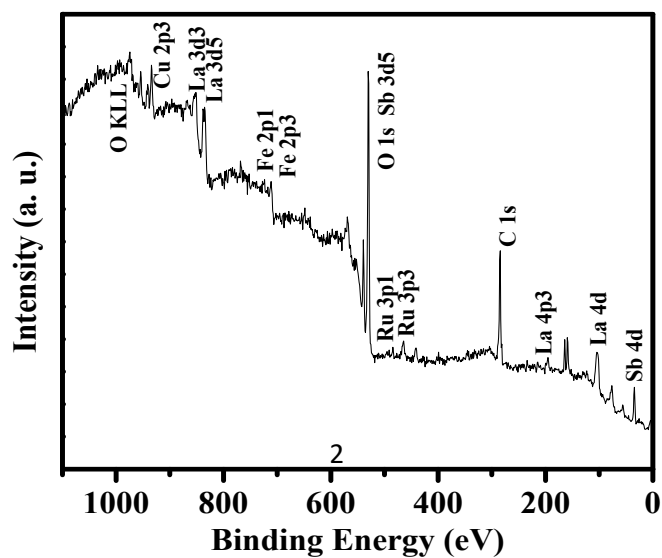


Fig. S3 Survey XPS of $\text{LaCu}_3\text{Fe}_2\text{RuSbO}_{12}$.

Table S1. Characteristic temperatures and adjusted pre-factors.

Characteristic temperatures	Value (K)	Adjusted pre-factors	Value
θ_D	140 ± 1.3	m	5.068 ± 0.008
θ_{E1}	276 ± 3.9	n_1	11.463 ± 0.048
θ_{E2}	825 ± 12.3	n_2	4.029 ± 0.018

Table S2. GII of $\text{LaCu}_3\text{Fe}_2\text{RuSbO}_{12}$ for different tilt systems.

Tilt System	GI (v.u.)
$a^+a^+a^+$	0.273
$a^+a^+c^-$	0.349
$a^-b^+a^-$	0.449
$a^-a^-a^-$	0.436
$a^0b^+b^+$	0.349
$a^+b^0c^-$	0.397
$a^0b^-b^-$	0.438
$a^0a^0c^+$	0.441
$a^0a^0c^-$	0.445
$a^0a^0a^0$	0.675

Table S3. GI, lattice parameter and space group of quadruple perovskites.

Compositions	GI (v.u.)	a (Å)	Space Group
$\text{CaCu}_3\text{Fe}_2\text{Sb}_2\text{O}_{12}$	0.029	7.497	$Pn-3$
$\text{LaCu}_3\text{Fe}_2\text{Sb}_2\text{O}_{12}$	0.106	7.531	$Pn-3$
$\text{CaCu}_3\text{Fe}_2\text{Ru}_2\text{O}_{12}$	0.021	7.469	$Pn-3$
$\text{LaCu}_3\text{Fe}_2\text{Ru}_2\text{O}_{12}$	0.096	7.501	$Pn-3$