Synthesis of freestanding single-crystal perovskite films and heterostructures

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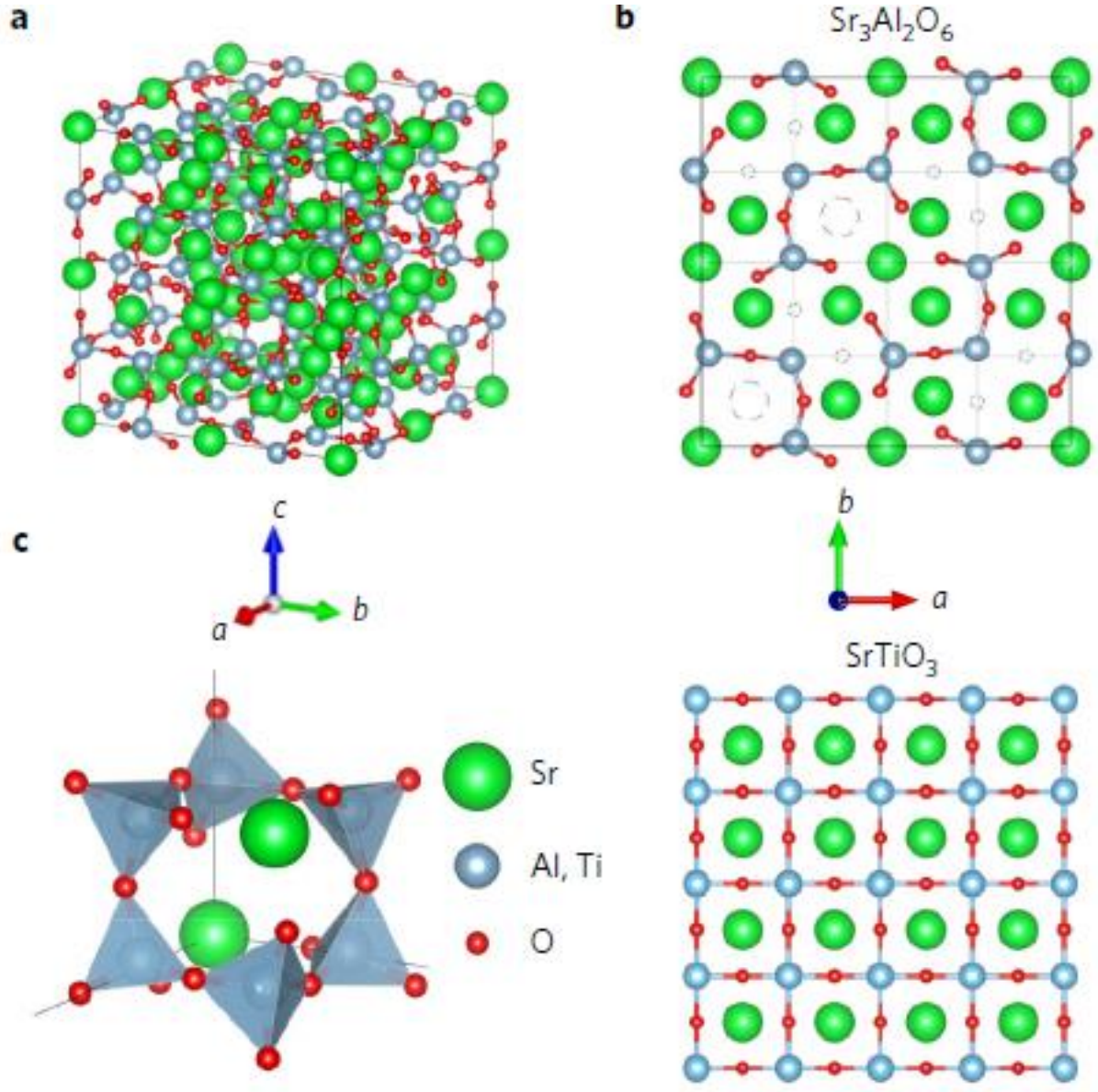
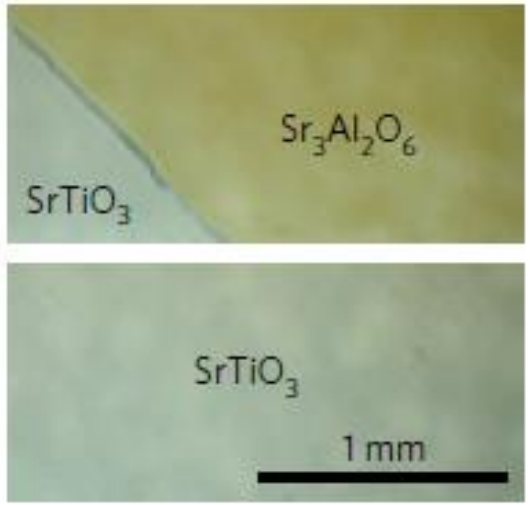




a, Cubic
lattice structure of Sr3Al2O6. b, (Top) Top 1/4 of the Sr3Al2O6 unit cell
projected onto the (001) plane. Dashed circles indicate vacancy sites.
(Bottom) 4_x0002_4 unit cells of the SrTiO3 crystal structure projected onto the
(001) plane. c, Al6O18
18 rings in Sr3Al2O6 consisting of AlO4 tetrahedra.

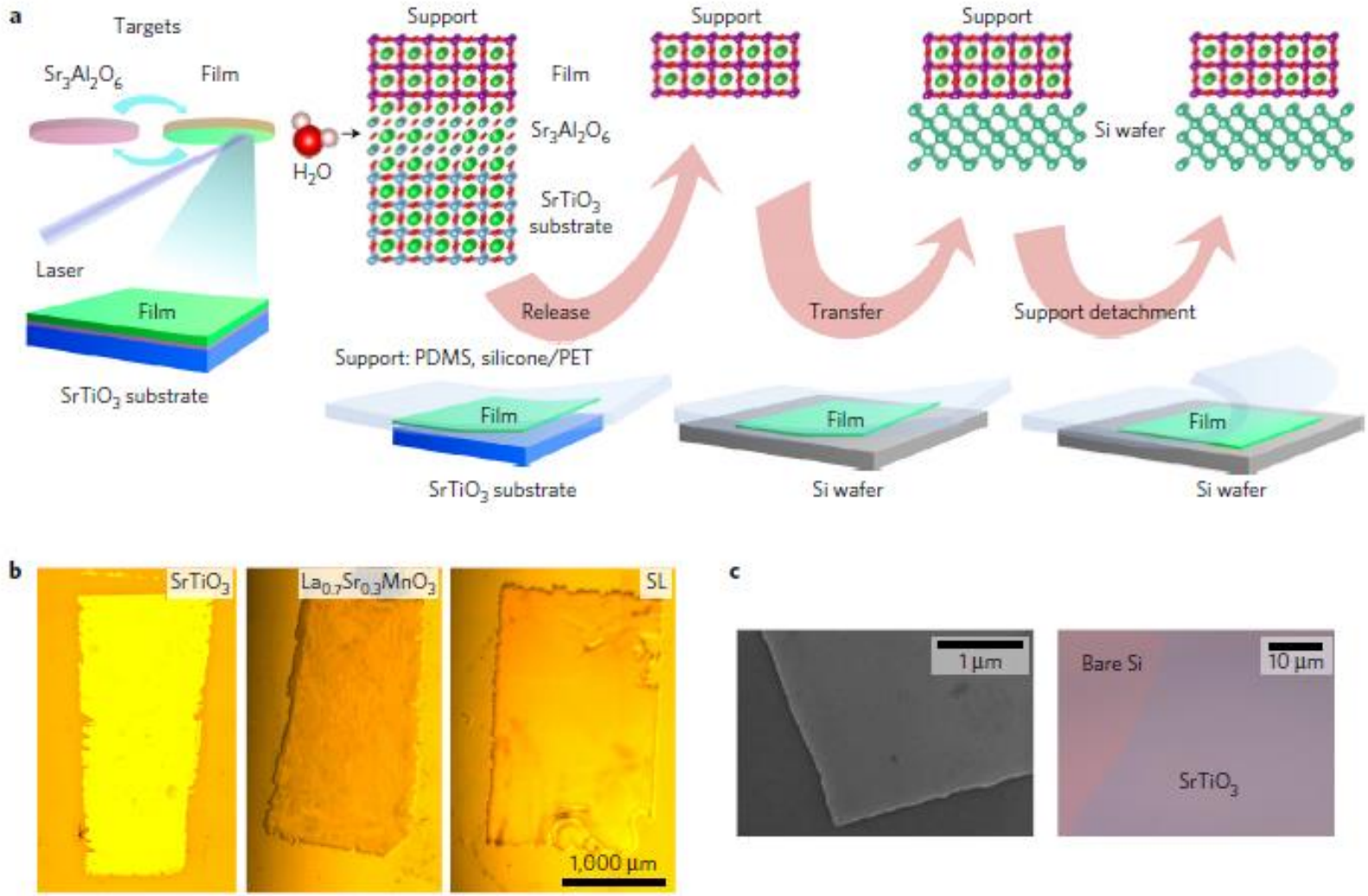
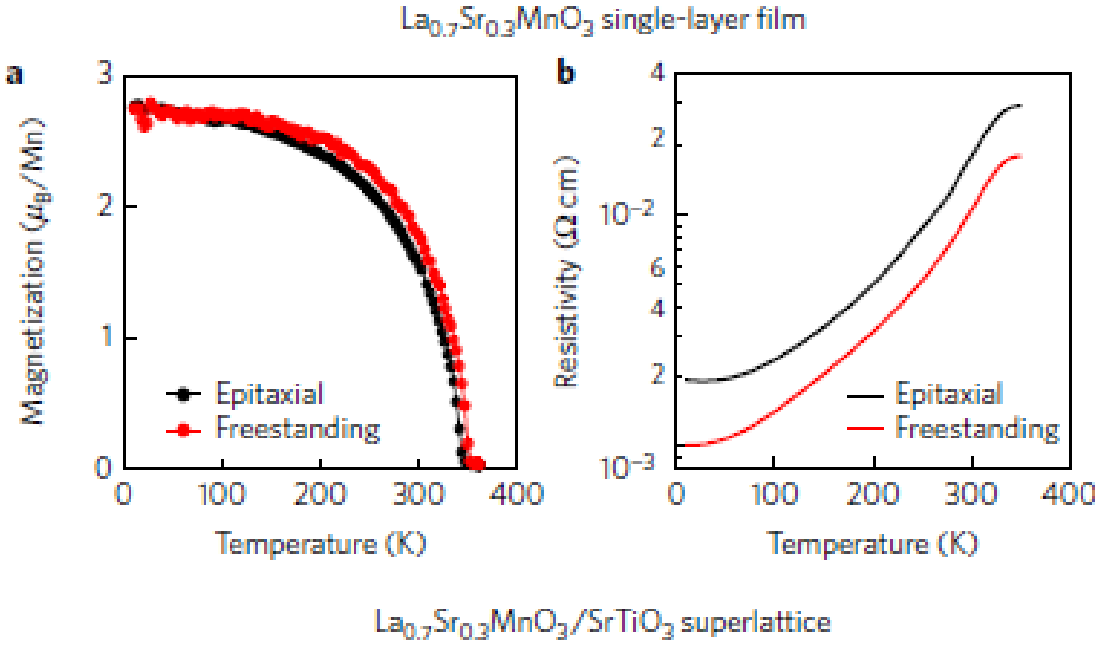


Figure 3 | Synthesis of freestanding perovskite membranes. a, Process schematic for heterostructure growth, oxide membrane release and transfer. **b**, Optical microscope images of ~80-nm-thick $SrTiO_3$, $La_{0.7}Sr_{0.3}MnO_3$, and SL (20 $SrTiO_3$ (5 unit cell)/$La_{0.7}Sr_{0.3}MnO_3$ (5 unit cell) repeats) freestanding membranes on PDMS support. **c**, SEM image of an 80-nm-thick $SrTiO_3$ (left) and optical microscope image of a 2-nm-thick $SrTiO_3$ (right) freestanding membrane transferred onto Si wafers.



freestanding membranes of oxide single crystals and heterostructures offer a unique opportunity to combine thin film heterostructure approaches with semiconductor device architectures32, flexible electronics33, and the growing family of exfoliated 2D materials.

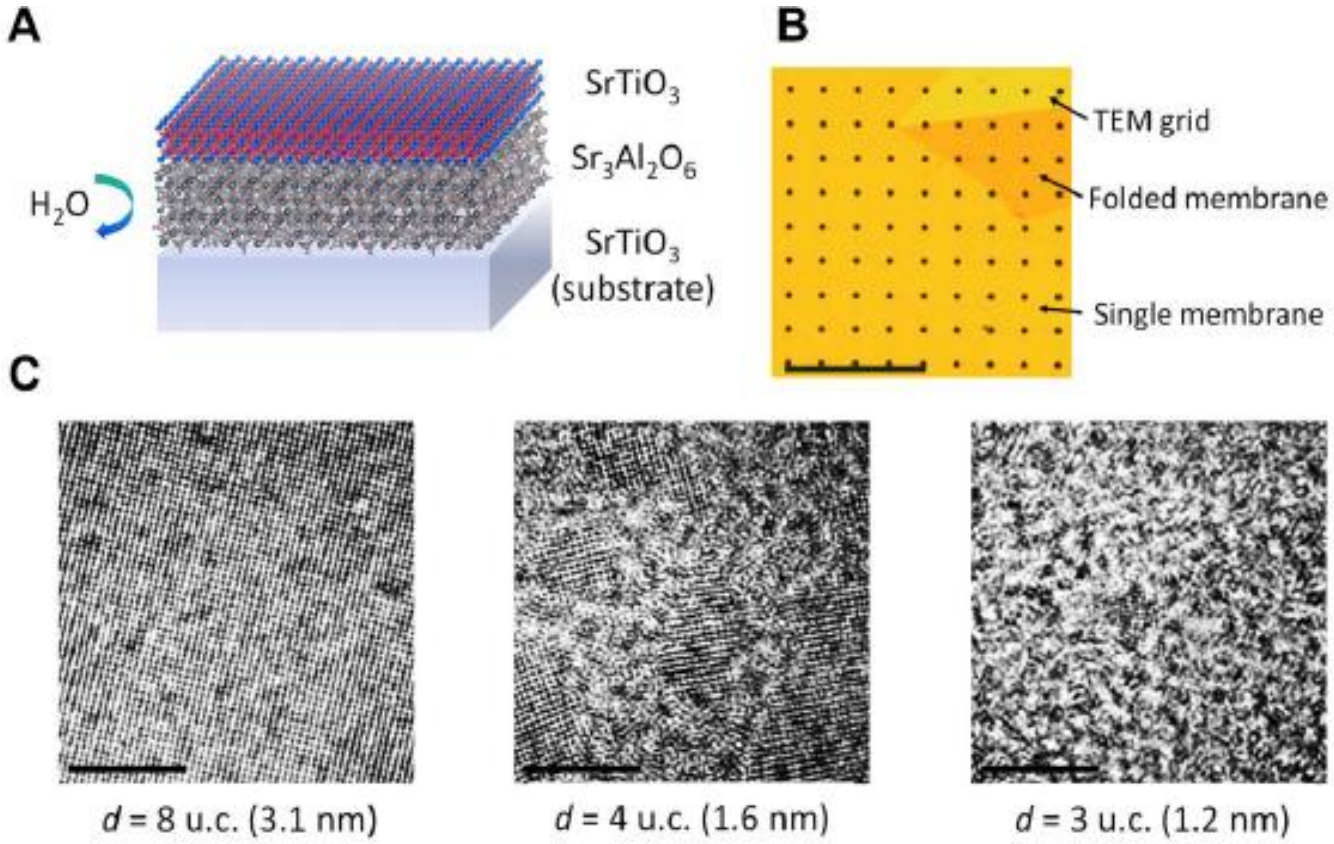
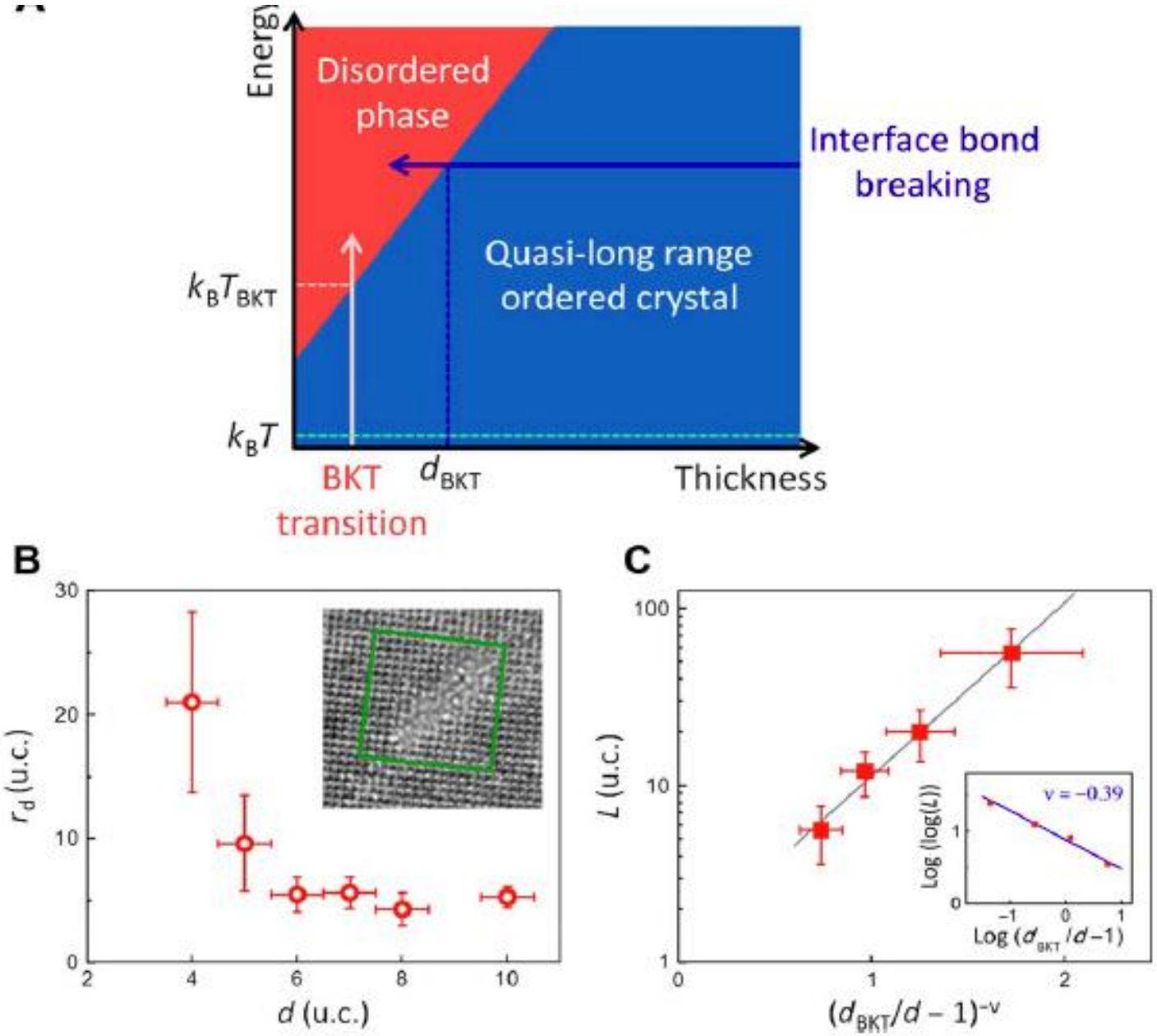
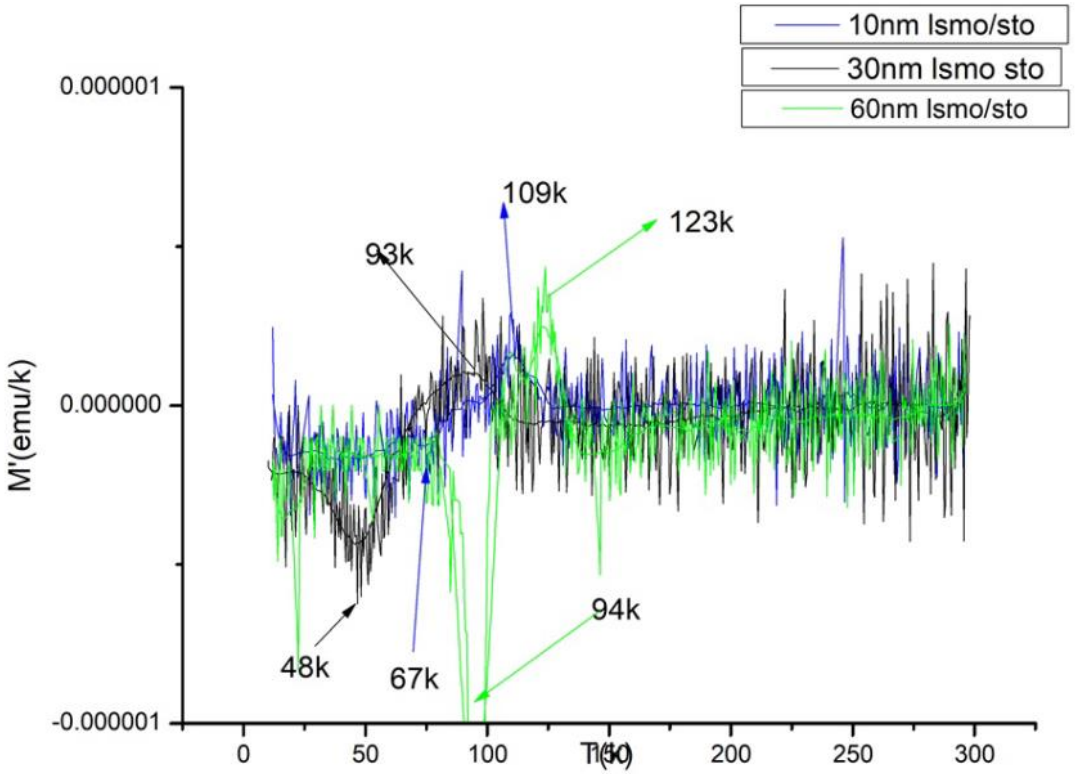


Fig. 1. Freestanding $SrTiO_3$ membranes of a few unit cell thicknesses. (**A**) A schematic $SrTiO_3/Sr_3Al_2O_6$ film heterostructure grown on a $SrTiO_3$ (001) substrate. The $Sr_3Al_2O_6$ layer is dissolved in room temperature water to release the top $SrTiO_3$ layer. (**B**) Optical image of a suspended $SrTiO_3$ membrane [6 unit cells (u.c.) in thickness] on a silicon nitride transmission electron microscopy (TEM) grid with 2-μm diameter holes. Scale bar, 50 μm. (**C**) High-resolution TEM (HR-TEM) images of $SrTiO_3$ membranes of different thicknesses. Scale bars, 10 nm.


Energy
Disordered phase
Interface bond breaking
Quasi-long range ordered crystal
k_BT_{BKT}
k_BT
BKT transition
d_{BKT}
Thickness
B
r_d (u.c.)
d (u.c.)
C
L (u.c.)
$(d_{BKT}/d - 1)^{-\nu}$
Log (log(L))
Log (d_{BKT}/d −1)
ν = −0.39

现在的工作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60nm lsmo/sto
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0.000000
-0.000001
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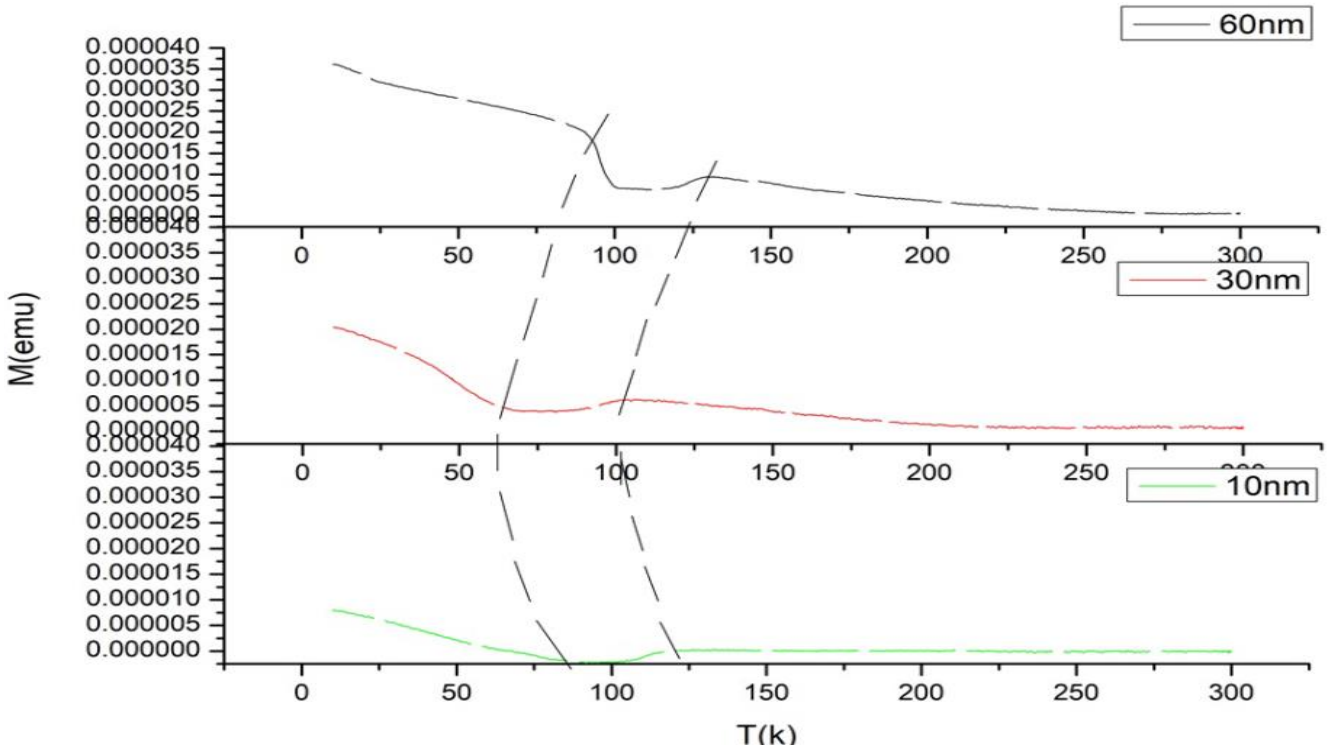
123k
93k
48k
67k
94k
0
50
100
150
200
250
300
T(k)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10nm
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0.000000
0
50
100
150
200
250
300
T(k)