High mobility transparent and conducting oxide films of La-doped SrSnO_3

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Abstract

The synthesis and characterization of high mobility thin films of La-doped SrSnO₃ are reported. The mobility for the 7% La-doped sample is found to be 228 cm² V⁻¹ s⁻¹. The observed high mobility is associated with the reduced carrier effective mass and scattering centers of various scattering mechanisms. The enhancement in mobility and the increase in carrier concentration after doping reduced the resistivities of the thin films by 5 orders of magnitude. X-ray absorption spectroscopy and X-ray photoelectron spectroscopy revealed that La-dopant and oxygen vacancies donate the electrons in the films. Films were highly transparent (> 90%) in the visible region. These materials have great potential to be used in the optoelectronic and heterostructure devices.

Full Text

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Figures

Figure 1

XRD patterns for $\text{La}_x\text{Sr}_{1-x}\text{SnO}_3$ thin films. The Bragg's reflections from substrate are marked with asterisks (*).

Figure 2

AFM images of (a) LSSO0, (b) LSSO3, (c) LSSO5, and (d) LSSO7 films.

Figure 3

XPS spectra of (a) C 1s and Sr 3p and (b) Sr 3d for $\text{LaxSr}_{1-x}\text{SnO}_3$ thin films.

Figure 4

XPS spectra of (a) O 1s and (b) Sn 3d for $\text{La}_x\text{Sr}_{1-x}\text{SnO}_3$ thin films.

Figure 5

XAS spectra of $\text{La}_x\text{Sr}_{1-x}\text{SnO}_3$ thin films.

(a)

(b)

Figure 6

(a) Temperature-dependent resistivity, and (b) plot of $\ln(\sigma T^{1/2})$ against $1000/T^{1/4}$ for LaxSr1-xSnO3 thin films.

Figure 7

Transmittance spectra of $\text{La}_x\text{Sr}_{1-x}\text{SnO}_3$ thin films.