P-type Semiconducting Behavior of BaSn$_{1-x}$Ru$_x$O$_3$ system

HYUKWOO KWON, JUYEON SHIN, KOOKRIN CHAR, Seoul National University — BaSnO$_3$ is a promising transparent perovskite oxide semiconductor due to its high mobility and chemical stability. Exploiting such properties, we have applied BaSnO$_3$ to the field effect, the 2-dimensional electron gas, and the pn-junction devices. In spite of the success of the K-doped BaSnO$_3$ as a p-type doped, its carrier density at room temperature is rather small due to its high activation energy of about 0.5 eV. In continuation of our previous study on SrSn$_{1-x}$Ru$_x$O$_3$ system, we studied the p-type semiconducting behavior of BaSn$_{1-x}$Ru$_x$O$_3$ system. We have epitaxially grown the BaSn$_{1-x}$Ru$_x$O$_3$ (0 ≤ x ≤ 0.12) thin films by pulsed laser deposition. X-ray diffraction measurements show that the films maintain a single phase over the entire doping range and the lattice constants of the system decrease monotonously as the doping increases. Transport measurements show that the films are semiconducting and their resistivities dramatically decrease as the Ru doping increases. Hall measurement data show that the charge carriers are p-type and its corresponding mobility values vary from 0.3 ~ 0.04 cm$^2$/V·s, depending on the doping rate. The hole carrier densities, measured to be $10^{17}$ ~ $10^{19}$ /cm$^3$, are larger than those of K-doped BaSnO$_3$. Using BaSn$_{1-x}$Ru$_x$O$_3$ and Ba$_{1-x}$La$_x$SnO$_3$ as p-type and n-type semiconductors, we will fabricate pn-junctions and report its performance.

Hyukwoo Kwon
Seoul National University

Date submitted: 13 Nov 2014
Electronic form version 1.4