Properties of Nonstoichiometric SrRu$_{1-v}$O$_3$ Perovskites

B. DABROWSKI, S. KOLESNIK, O. CHMAISSEM, J. MAIS, Department of Physics, Northern Illinois University, M. AVDEEV, J.D. JORGENSEN, Materials Science Division, Argonne National Laboratory — Annealing of stoichiometric SrRuO$_3$ perovskites in high-pressure oxygen of 600 atm. near 1100°C produces SrRu$_{1-v}$O$_3$ compounds with vacancies on the Ru-sites. The creation of Ru vacancies rapidly suppresses the ferromagnetic ordering temperature, $T_C$, from 163 K to 45 K with increase of $v \approx 0.09$. The resistivity shows a metallic behavior near room temperature with progressively more insulating behavior at low temperatures for increasing $v$. All samples display clear metallic-like decrease of the resistivity and negative magneto-resistance right below $T_C$. Structural changes that accompany creation of Ru-site vacancies indicate reduced charge screening caused by the Ru-vacancies that offsets expected decrease of the average interatomic distance Ru–O. The $b$ and $c$ lattice parameters and the unit cell volume are virtually temperature independent for the stoichiometric material below $T_C$. We show that this previously reported invar-effect originates from freezing of the octahedral tilting about the [001] axis that can be observed for both stoichiometric and Ru-deficient samples. Spontaneous magnetostriction has the largest effect on the $b$ axis of the orthorhombic Pbnm crystal structure.

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