High-pressure crystal growth and magnetic and electrical properties of the quasi-one dimensional osmium oxide $\text{Na}_2\text{OsO}_4$


$\text{Na}_2\text{OsO}_4$ crystals were grown by a NaCl flux method under high pressure. It was found that $\text{Na}_2\text{OsO}_4$ crystallizes in the Ca$_2$IrO$_4$-type structure, which consists of OsO$_6$ octahedra chains, rather than in the K$_2$NiF$_4$-type. A chain-magnetism was thus expected for the crystal because of the electronic configuration of Os$^{6+}$O$^6$(5$d^2$, $S = 1$). However, experimental data suggested the $S = 0$ state for the crystal rather than the $S = 1$ state. We carefully investigated the crystal to resolve the contradiction between the expectation and the observation, and found that the absence of the chain-magnetism is likely due to statically uniaxial compression of the OsO$_6$ octahedra, resulting in splitting of the $t_{2g}$ band. The localized 2 electrons per Os are probably paired in the $t_{2g}$ band, forming the $S = 0$ state. We will discuss details of the issue. This research was supported in part by the WPI Initiative on Materials Nanoarchitectonics from MEXT, Japan, and the Grants-in-Aid for Scientific Research (20360012) from JSPS. Work at Argonne National Laboratory supported under Contract No. DE-AC02-06CH11357 by UChicago Argonne, LLC, Operator of Argonne National Laboratory, a U.S. Department of Energy Office of Science Laboratory.

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Date submitted: 27 Oct 2009

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