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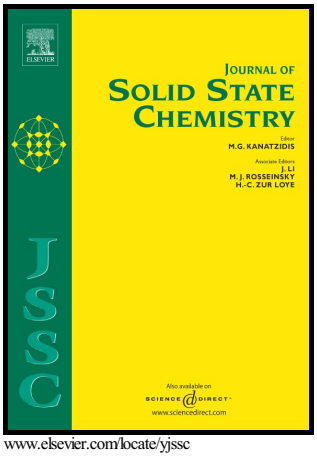

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$La_{15}Nb_xGe_9$: a superstructure of the Mn_5Si_3 structure type with interstitial Nb atoms

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Abstract

The crystal structure and elementary properties of $La_{15}Nb_xGe_9$ are reported. Single-crystal X-ray diffraction, from a crystallite with only 0.12 Nb/formula unit, reveals that this compound, although transition metal deficient, crystallizes in a hexagonal "15-1-9"-like structure type, space group P6_3mc (no. 186) with lattice parameters $a = b$ = 15.5017(2) Å, c = 6.9173(2) Å. The physical properties were examined by specific heat and resistivity measurements. $La_{15}Nb_{0.4}Ge_9$ shows metallic behavior, and no superconductivity is observed above 0.4 K. The Sommerfeld coefficient (γ = 62.41(8) mJ mol^{-1} K^{-2}) and the Debye temperature (θ_D = 267(1) K) were estimated from a fit to the low temperature heat capacity data. $La_{15}Nb_{0.4}Ge_9$ is the first reported compound in the ternary La-Nb-Ge system.

Keywords: intermetallic compounds, crystal structure determination, heat capacity, resistivity

Introduction

In the search for superconductivity in new materials, one philosophy is to search for combinations of favorable chemical elements in promising crystal structures.[1] Among all chemical elements only a few superconduct at temperatures above 6 K under normal pressures. The record holder is niobium with T_c = 9.3 K followed by technetium, lead, and β-lanthanum with T_{sc} = 7.5 K, 7.3 K, and 6.3 K, respectively. These elements are therefore reasonable targets to include in a search for new superconducting compounds.