

$\text{La}_{15}\text{Nb}_x\text{Ge}_9$ : a superstructure of the  $\text{Mn}_5\text{Si}_3$  structure type with interstitial Nb atoms

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**La<sub>15</sub>Nb<sub>x</sub>Ge<sub>9</sub>: a superstructure of the Mn<sub>5</sub>Si<sub>3</sub> structure type with interstitial Nb atoms**J. Bławat<sup>1</sup>, M. Roman<sup>1</sup>, Weiwei Xie<sup>2</sup>, R. J. Cava<sup>3</sup> and T. Klimczuk<sup>1,\*</sup>

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**Abstract**

The crystal structure and elementary properties of La<sub>15</sub>Nb<sub>x</sub>Ge<sub>9</sub> 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<sub>3</sub>mc* (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<sub>15</sub>Nb<sub>0.4</sub>Ge<sub>9</sub> shows metallic behavior, and no superconductivity is observed above 0.4 K. The Sommerfeld coefficient ( $\gamma = 62.41(8)$  mJ mol<sup>-1</sup> K<sup>-2</sup>) and the Debye temperature ( $\theta_D = 267(1)$  K) were estimated from a fit to the low temperature heat capacity data. La<sub>15</sub>Nb<sub>0.4</sub>Ge<sub>9</sub> 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.<sup>1</sup> 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  $\beta$ -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.

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