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Crystal Structures and Physical Properties of One-Dimensional Borides $A_{1+\varepsilon}M_4\mathbf{B}_4$ (A = Ca, Y; La; M = Fe, Co, Ru) YUKARI KATSURA, HIRAKU OGINO, YUTAKA MATSUMURA, SHIGERU HORII, JUN-ICHI SHIMOYAMA, KOHJI KISHIO, Dept. of Applied Chemistry, Univ. of Tokyo — We investigated crystal structures and physical properties of $La_{1+\varepsilon}Fe_4B_4$ ($\varepsilon \sim 0.06$) and three new borides $Y_{1+\varepsilon}Fe_4B_4$($\varepsilon \sim 0.16$), $CaCo_4B_4$ and $Ca_{1+\varepsilon}Ru_4B_4$ ($\varepsilon \sim 0.13$). Polycrystalline bulk samples were obtained by reacting metal boride precursors (FeB, CoB, RuB) with Ca, Y and La metals. Microstructure were analyzed using a SEM with an EDX. Crystal structures were analyzed through TEM studies and Rietveld analysis of powder XRD patterns. Electrical resistivity and magnetization measurements were carried out from 1.8 to 300 K. We found that all these compounds belong to the same structural family as $RE_{1+\varepsilon}Fe_4B_4$ (RE = La-Tm): a tetragonal lattice composed of one-dimensional channels of FeB and single atomic chains of RE. Incommensurate structures along c-axis were observed in $La_{1+\varepsilon}Fe_4B_4$, $Y_{1+\varepsilon}Fe_4B_4$ and $Ca_{1+\varepsilon}Ru_4B_4$. The $La_{1+\varepsilon}Fe_4B_4$ bulks exhibited type-II superconductivity below 6.0 K, although this might be due to the superconductivity of dirty β-La remained in the bulks. The other new borides did not show superconductivity down to 1.8 K.

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