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Synthesis and Superconductivity in Pb-doped $NbSr_2RECu_2O_z$ ($z \approx 8$; RE: rare-earth element)

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Substitution effects of Pb for Nb in $NbSr_2RECu_2O_z$ (Nb-"1-2-1-2"; RE: rare-earth element) are investigated. The first Nb-"1-2-1-2", $NbBa_2LaCu_2O_z$ and $NbBa_2PrCu_2O_z$, were synthesized for the first time in 1991 by Ichinose *et al.* [1] and they did not exhibit superconductivity. Kim *et al.* [2] reported in 2013 that Sn doping into their related compounds, $NbSr_2RECu_2O_z$ *(RE=Sm, Eu)*, made them superconducting with superconducting transition temperature (T_c) of ~30K by generating carriers due to Sn^{4+} partial substitution for Nb^{5+}. In this study, doping effects of Pb^{4+} instead of Sn^{4+} in the Sr-containing Nb-"1-2-1-2" are reported mainly focusing on the occurrence of superconductivity.
Samples were prepared by a solid-state reaction method using Nb_2O_5, PbO, $SrCO_3$, RE_2O_3 (RE=Nd, Sm, Eu, Gd) and CuO. Nominal compositions of $(Nb_{1-x}Pb_x)Sr_2RECu_2O_z$ ($0 \leq x \leq 0.4$) were used. Sintering was carried out in air at temperatures of 1000~1080˚C and post-annealing was performed in a flowing O_2 gas at 800˚C. Characterization of the samples was carried out by means of powder X-ray diffraction (XRD) and the electrical resistivity was measured by a four-probe method.
For the Pb-doped Nb-"1-2-1-2", superconductivity is observed only for the post-annealed samples of RE=Sm, RE=Eu and RE=Gd. This shows that oxygen nonstoichiometry plays an crucial role for the occurrence of superconductivity in these compounds. The maximum value of T_c observed in this study is 43 K (onset) for $(Nb_{0.8}Pb_{0.2})Sr_2EuCu_2O_z$. Some characteristics of the superconductivity in the Nb-"1-2-1-2" will be discussed.

[1] A. Ichinose *et al.*, J. Ceram Soc. Jpn. **97**, 1065-1070 (1989). (in Japanese)
[2] K. Kim *et al.*, Physica C**492**, 165-167 (2013).

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