

PREPARATION AND PROPERTIES OF DOPED Hg-BASED SUPERCONDUCTING COPPER OXYDES

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The superconducting mercury cuprate $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$ shows the highest critical temperature $T_c = 133 \text{ K}$ [1]. Unfortunately, there are still problems concerning the phase stability, especially in the presence of CO_2 and humidity. The chemical stabilization of $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$ phase is desirable. It was reported that the doping with high-valence type Re, Pb and another elements has beneficial effects on both phase stability and superconducting properties of the $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$ phase [2].

Samples of Pb, Fe and Cd doped mercury superconductor $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$ were prepared employing highly homogeneous and reactive Hg-free precursor $\text{Ba}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$ obtained by the sol-gel method. The acetates of Ba, Ca, Cd, Cu, Pb and Fe were used. Samples of mercury superconductor $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$ by reacting HgO and precursor in sealed quartz ampoules were prepared.

According to microstructure and microprobe analyses fine homogeneous Hg-free precursor was obtained. By the electrical and magnetic properties of ceramics increasing its stability and critical current were showed [3].

The temperature dependencies of resistivity of Pb, Fe and Cd doped $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$ ceramics after synthesis and annealing in flowing oxygen and argon atmosphere were demonstrated. The form of superconducting transitions and critical temperatures (based on the derivative of the resistivity with temperature dp/dT) were presented. After synthesis the samples were in overdoped state and reach to the optimum in flowing argon.

The magnetization versus temperature (4.2–140K) and magnetic field (to 15 kOe) measurements for different kind of doped elements was showed. There are two step dependencies on superconducting transitions which correlate with electric measurements. The Fe doped samples of $\text{HgBa}_2\text{Ca}_2\text{Cu}_3\text{O}_{8+\delta}$ show decreasing T_c but lead to pinning enhancing of intergranular medium. From the other side, the Cd doping increased the current inside superconducting grains.

References

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