

PENGARUH PREKURSOR NON STOIKIOMETRIS TERHADAP PEMBENTUKAN FASA SUPERKONDUKTOR YBCO DAN PENGARUH DOPING Ca TERHADAP STRUKTUR KRISTAL SUPERKONDUKTOR YBCO

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ABSTRAK

PENGARUH PREKURSOR NON STOIKIOMETRIS TERHADAP PEMBENTUKAN FASA SUPERKONDUKTOR YBCO DAN PENGARUH DOPING Ca TERHADAP STRUKTUR KRISTAL SUPERKONDUKTOR YBCO. Pengaruh prekursor non stoikiometris terhadap pembentukan fasa superkonduktor YBCO dan pengaruh doping Ca terhadap struktur kristal superkonduktor YBCO telah diteliti. Dalam penelitian ini disintesis empat jenis cuplikan YBCO dengan metode reaksi padatan dari bahan baku serbuk Y_2O_3 , $BaCO_3$, $CaCO_3$ dan CuO . Stoikiometri prekursor keempat jenis cuplikan adalah $Y_{1,80}Ba_{2,40}Cu_{3,400}O_{7-x}$, $(Y_{0,95}Ca_{0,05})Ba_{1,595}Cu_{2,405}O_{7-x}$, $(Y_{0,80}Ca_{0,20})Ba_{2,000}Cu_{3,000}O_{7-x}$, dan $YBa_2Cu_3O_{7-x}$. Cuplikan dikalsinasi pada $T_k = 900^\circ C$ selama 5 jam, kemudian dikarakterisasi dengan teknik difraksi sinar-X. Serbuk YBCO hasil kalsinasi dipelet, kemudian disinter pada $T_s = 940^\circ C$ selama 10 jam. Cuplikan hasil sinter dikarakterisasi dengan teknik difraksi sinar-X, dan efek Meissner. Data-data difraksi sinar-X dianalisis dengan metode Rietveld. Hasil analisis menunjukkan bahwa fasa 123 dan fasa 211 lebih mudah terbentuk jika digunakan prekursor YBCO non stoikiometris. Jika digunakan prekursor stoikiometris, fasa 123 baru terbentuk sempurna setelah proses sintering dan tidak disertai fasa 211. Pendopingan prekursor YBCO non stoikiometris dengan 0,05 mol Ca, menyebabkan atom-atom kalsium masuk ke dalam struktur kristal fasa 123 menggantikan sebagian atom-atom Y, dan tidak terjadi transisi fasa. Namun manakala prekursor didoping dengan 0,2 mol Ca, struktur fasa 123 berubah dari ortorombik menjadi tetragonal. Dengan prekursor $(Y_{0,95}Ca_{0,05})Ba_{1,595}Cu_{2,405}O_{7-x}$ dapat ditumbuhkan fasa 123 dan fasa 211, dimana perbandingan kuantitas kedua fasa tersebut mendekati ideal (75% : 25%), juga dihasilkan fasa 123 yang memiliki panjang ikatan Cu(2)-O(3) paling pendek. Dikonfirmasi bahwa efek Meissner superkonduktor YBCO peka terhadap jumlah mol atom O, tetapi tidak peka terhadap jumlah mol atom-atom logam Y, Ba, dan Cu.

Kata kunci : Prekursor YBCO non stoikiometris, Doping Ca, Struktur kristal

ABSTRACT

INFLUENCE OF THE OFF STOICHIOMETRIC PRECURSOR TO THE FORMATION OF THE YBCO SUPERCONDUCTOR PHASE AND INFLUENCE OF Ca DOPING TO THE CRYSTAL STRUCTURE OF YBCO SUPERCONDUCTOR. Influence of the off stoichiometric precursor to the formation of the YBCO superconductor phase and influence of Ca doping to the crystal structure of YBCO superconductor have been investigated. In this research it were synthesized four type of YBCO samples with solid state reaction method from the powdered raw material of Y_2O_3 , $BaCO_3$, $CaCO_3$ and CuO . The fourth type of samples were $Y_{1,80}Ba_{2,40}Cu_{3,400}O_{7-x}$, $(Y_{0,95}Ca_{0,05})Ba_{1,595}Cu_{2,405}O_{7-x}$, $(Y_{0,80}Ca_{0,20})Ba_{2,000}Cu_{3,000}O_{7-x}$, and $YBa_2Cu_3O_{7-x}$. The samples were calcinated at $T_k = 900^\circ C$ for 5 hours, then characterized with x-ray diffraction technique. The resulted YBCO powders were pressed into pellet, then sintered at $T_s = 940^\circ C$ for 10 hours. The resulted samples were characterized with x-ray diffraction technique, and Meissner effect. The x-ray diffraction datas were analyzed with the Rietveld method. The result of analysis indicate that the 123 phase and 211 phase were easier formed if it was used the off stoichiometric YBCO precursor. But if the stoichiometric YBCO precursor was used, the 123 phases was just formed perfectly after sintering process and with no second phase of 211 phase. Doping of the off stoichiometric YBCO precursor with 0.05 mole of Ca lead to substitution of some Y atoms with Ca within 123 phase crystal structure, and there is no phase transition. But when the precursor was doped with 0.2 mole of Ca, the 123 phase structure change from orthorombic to tetragonal. With precursor of $(Y_{0,95}Ca_{0,05})Ba_{1,595}Cu_{2,405}O_{7-x}$, the 123 phase and 211 phase can be grown having the ratio close to the ideal composition of (75 : 25 %), and shortest Cu(2)-O(3) chain in its 123 phase. It was confirmed that Meissner effect of YBCO superconductor sensitive to the mole amount of O atom, but it was not sensitive to the mole amount of Y, Ba and Cu metal atoms.

Key words : The off stoichiometric YBCO precursor, Ca doping, Crystal structure