

## PENGARUH KOMPOSISI BAHAN BAKU SECARA STOIKIOMETRI TERHADAP SIFAT SUPERKONDUKTOR SISTEM $Bi_2Sr_2Ca_{n-1}Cu_nO_x$

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### INTISARI

Telah dilakukan penelitian untuk mempelajari pengaruh komposisi bahan baku secara stoikiometri terhadap sifat superkonduktor sistem  $Bi_2Sr_2Ca_{n-1}Cu_nO_x$  dengan  $n=2-5$  yang disintering pada suhu  $750^\circ\text{C}$  dengan tiga variasi lama waktu sintering, 90, 24 dan 5 jam. Bahan-bahan yang digunakan yaitu  $Bi_2O_3$ ,  $SrCO_3$ ,  $CaO$ ,  $CuO$  dan  $PbO_2$ , semua bahan dalam bentuk serbuk. Sintesis superkonduktor dilakukan dengan metode metalurgi serbuk, dimana prosesnya meliputi penimbangan serbuk, pencampuran, peletisasi dan sintering. Penimbangan bahan dihitung berdasarkan perbandingan mol dari sampel dengan rumus kimia  $Bi_2Sr_2Ca_1Cu_2O_x$ ,  $Bi_2Sr_2Ca_2Cu_3O_x$ ,  $Bi_2Sr_2Ca_3Cu_4O_x$ ,  $Bi_2Sr_2Ca_4Cu_5O_x$ ,  $Bi_{1,6}Pb_{0,4}Sr_2Ca_3Cu_4O_x$ . Pengaruh komposisi, suhu sintering dan waktu penahanan dianalisis dengan XRD untuk melihat fasa yang terbentuk, analisis resistivitas dengan alat Cryogenic untuk melihat sifat superkonduktor (nilai  $T_c$ ), analisis SEM untuk mengetahui bentuk struktur mikronya.

Hasil penelitian menunjukkan bahwa sampel A1 ( $n=2$ ) yang disintering pada suhu  $750^\circ\text{C}$  selama 90 jam memiliki nilai  $T_c=84,72$  K. Nilai  $T_c$  menurun seiring dengan penambahan jumlah  $n$  (B1, C1) dan doping Pb (E1), besar  $T_c$  masing-masing secara berturut-turut, 78,47 K ; 77,77 K ; 70 K). Sampel yang disintering selama 24 jam, hanya sampel A2 dan E2 yang memiliki nilai  $T_c$  yaitu 85 K dan 80 K. Pada sintering selama 5 jam, sampel tidak memperlihatkan sifat superkonduktor. Berdasarkan analisis XRD sampel A, B, C, dan D dengan sintering selama 90, 24, dan 5 jam diketahui terbentuk fasa yang sama, yaitu  $Bi_2(Sr_{1,6}Ca_{0,4})CuO_6$  dengan struktur kristal ortorombik dan parameter kisi  $a=5,382$  Å,  $b=5,376$  Å,  $c=24,384$  Å, sementara itu dengan doping Pb terbentuk fasa  $(Bi_{1,6}Pb_{0,4})Sr_{1,81}CaCu_2O_{8,716}$  dengan struktur kristal ortorombik dan parameter kisi  $a=5,347$  Å,  $b=5,416$  Å,  $c=30,670$  Å.

**Kata kunci:** Superkonduktor,  $Bi_2Sr_2Ca_{n-1}Cu_nO_x$ , metalurgi serbuk, sintering.

**EFFECT OF COMPOSITION OF RAW MATERIALS FOR  
STOICHIOMETRY ON THE SUPERCONDUCTING PROPERTIES OF  
 $\text{Bi}_2\text{Sr}_2\text{Ca}_{n-1}\text{Cu}_n\text{O}_x$  SYSTEM**

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**ABSTRACT**

Research to study the superconducting properties of  $\text{Bi}_2\text{Sr}_2\text{Ca}_{n-1}\text{Cu}_n\text{O}_x$  superconductors with  $n=2-5$  was conducted, sintering at low temperature is  $750^\circ\text{C}$  with three variations of sintering time, 90 h, 24 h and 5 h. The materials used are  $\text{Bi}_2\text{O}_3$ ,  $\text{SrCO}_3$ ,  $\text{CaO}$ ,  $\text{CuO}$  and  $\text{PbO}_2$ . All materials are powder. Synthesis of superconductor was conducted with powder metallurgy method, wherein the process includes weighing the powder, mixing, pelletization and sintering. Weighing ingredients are calculated based on the mole ratio of the sampel with the chemical formulas  $\text{Bi}_2\text{Sr}_2\text{Ca}_1\text{Cu}_2\text{O}_x$ ,  $\text{Bi}_2\text{Sr}_2\text{Ca}_2\text{Cu}_3\text{O}_x$ ,  $\text{Bi}_2\text{Sr}_2\text{Ca}_3\text{Cu}_4\text{O}_x$ ,  $\text{Bi}_2\text{Sr}_2\text{Ca}_4\text{Cu}_5\text{O}_x$ , and  $\text{Bi}_{1.6}\text{Pb}_{0.4}\text{Sr}_2\text{Ca}_3\text{Cu}_4\text{O}_x$ . The influence of the composition, sintering temperature and holding time were analyzed by XRD to see the phases formed, the analysis of the resistance with Cryogenic to see the electrical characteristics ( $T_c$ ), SEM analysis is aims to determine the microstructure and analysis of EDX is aims to determine the phase formed from elements of the existing and amount in an area that is mapped.

Samples with sintering at  $750^\circ\text{C}$  for 90 h, the results obtained show that A1 ( $n=2$ ) sampel has a value of  $T_c= 84,72\text{K}$ .  $T_c$  decreases with increasing the number of  $n$  (B1,C1) and Pb doped (E1), respectively  $T_c= 78,47\text{ K}$ ;  $77,77\text{ K}$ ;  $70\text{ K}$ . While the samples with sintering at  $750^\circ\text{C}$  for 24 h, only the A2 sample and E2 sample has a value of  $T_c$ , respectively  $85\text{ K}$  and  $80\text{ K}$ . Samples with sintering at  $750^\circ\text{C}$  for 5 h, all of samples did not exhibit superconducting properties. XRD analysis of the samples A, B, C, and D by sintering for 90 h, 24 h, and 5 h resulted the same phase formation,  $\text{Bi}_2(\text{Sr}_{1.6}\text{Ca}_{0.4})\text{CuO}_6$ ; with the crystal structure as orthorhombic and lattice parameters are  $a=5.382\text{ \AA}$ ,  $b=5.376\text{ \AA}$ ,  $c=24.384\text{ \AA}$ . While sample with Pb doped, formed the phase  $(\text{Bi}_{1.6}\text{Pb}_{0.4})\text{Sr}_{1.81}\text{CaCu}_2\text{O}_{8.716}$  with orthorhombic crystal structure and lattice parameters are  $a=5.347\text{ \AA}$ ,  $b=5.416\text{ \AA}$ , and  $c=30.670\text{ \AA}$ .

**Keywords:** Superconductors,  $\text{Bi}_2\text{Sr}_2\text{Ca}_{n-1}\text{Cu}_n\text{O}_x$ , powder metallurgy, sintering.