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ABSTRACT

The effects of the elemental substitution on the 1212 phase formation and superconducting properties of $(Tl,Bi)(Sr,Ti)_2Ca_{0.9}Y_{0.1}Cu_2O_7$ and $(Tl,Pb)(Sr,M)_2CaCu_2O_7$ (M = Yb, Sb) series have been investigated. The samples were prepared using high purity oxides by solid state and precursor method. Crystal structures of the samples were analyzed using X-ray powder diffraction method while microstructures were investigated by scanning electron microscope (SEM). Measurements of electrical resistance were carried out using standard four-point-probe method. Powder X-ray diffraction patterns for $Tl_{0.9}Bi_{0.1}Sr_{2-y}Ti_yCa_{0.9}Y_{0.1}Cu_2O_7$ ($y = 0 - 0.5$) with Bi, Ti and Y triple substitution revealed that all the samples consist mostly of major 1212 and minor 1201 crystalline phases. Temperature dependent resistance measurements on $Tl_{1-x}Bi_xSr_{1.9}Ti_{0.1}Ca_{0.9}Y_{0.1}Cu_2O_7$ ($x = 0 - 0.6$) showed optimum superconductivity for $x = 0.3$ with $T_{c\ onset}$ of 93.3 K and $T_{c\ zero}$ of 68.2 K Temperature dependent electrical resistance measurements on $Tl_{1-m}Pb_mSr_{1.8}Yb_{0.2}CaCu_2O_7$ ($m = 0.1- 0.5$) showed metallic normal state behaviors and increase in $T_{c\ zero}$ from 61.1 K at $m = 0.1$ to a maximum value of 101.1 K at $m = 0.5$. Substitutions of Yb at Sr-site of $Tl_{0.5}Pb_{0.5}Sr_{2-n}Yb_nCaCu_2O_7$ with $n = 0 - 0.6$ increased value of in $T_{c\ zero}$ from 62.2 K at $n = 0$ to a maximum value of 101.1 K at $n = 0.2$. Substitution of Pb at Tl-site and Sb at Sr-site in $Tl_{1-q}Pb_qSr_{1.8}Sb_{0.2}CaCu_2O_7$ ($q = 0.1 - 0.6$) promote 1212 phase formation and increased in $T_{c\ zero}$ from 26.1 K at $q = 0.1$ to 80.2 K at $q = 0.5$. From this study, it is found that apart from the Tl and Ca sites, Sr-site substitution is also effective in optimizing critical temperature, T_c and critical current density, J_c of Tl1212 samples. The results were discussed in terms of the concept of average copper valence and ionic radius of elements.

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Candidate's Declaration

I declare that work in this thesis was carried out in accordance with regulations of Universiti Teknologi MARA. It is original and is the result of my work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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Date : 9 September 2005

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