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CHANGES IN DOPING STATE AND TRANSPORT CRITICAL CURRENT DENSITY OF (Tl,Pb)(Sr,Yb)$_2$CaCu$_2$O$_7$ CERAMICS

W.F.Abdullah[a], M.H. Jumali[b], A.K.Yahya [a*]

[a]*Faculty of Applied Science,*
Universiti Teknologi MARA,
40450 Shah Alam, Selangor.

[b]*School of Applied Physics,*
Universiti Kebangsaan Malaysia,
43600 Bangi, Selangor.

E-mail : ahmad191@salam.uitm.edu.my

ABSTRACT

Two series of samples with nominal compositions of $Tl_{1-x}Pb_xSr_{1.8}Yb_{0.2}CaCu_2O_7$ (x = 0.1 – 0.6) and $Tl_{0.5}Pb_{0.5}Sr_{2-y}Yb_yCaCu_2O_7$ (y = 0 – 0.6) were synthesized using solid-state method and characterized by electrical resistance (dc) measurements and powder X-ray diffraction analysis. Temperature dependent electrical resistance measurements on $Tl_{1-x}Pb_xSr_{1.8}Yb_{0.2}CaCu_2O_7$ (x = 0.1 – 0.5) showed metallic normal state behaviors and increase in $T_{c\ zero}$ from 61 K at x = 0.1 to a maximum value of 101 K at x = 0.5. At x = 0.6 the normal state behavior remained metallic but $T_{c\ zero}$ slightly decreased to 98 K. Substitution of Yb at Sr-site of $Tl_{0.5}Pb_{0.5}Sr_{2-y}Yb_yCaCu_2O_7$ for y = 0 – 0.2 caused an increase in $T_{c\ zero}$ from 62 K (y = 0) to a maximum value of 93 K (y = 0.2). However, further substitution of Yb caused $T_{c\ zero}$ to decrease from 64 K at y = 0.3 to 34 K at y = 0.5. Superconductivity was not observed down to 16 K for y = 0.6. Results of transport critical current density measurements and powder X-ray diffraction are presented. The effects of Pb and Yb substitutions on superconductivity of Tl1212 are discussed in terms of ionic radius of elements, Tl 1212 phase formation and the concept of average Cu valence.

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