

Superconductivity in the 100-120 K region in oxides of the Tl-Ca-Ba-Cu-O system⁺

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MS received 21 March 1988

Abstract. Oxides with different cation ratios 2122, 2212, 2213 and 2223 in the Tl-Ca-Ba-Cu-O system exhibit onset of superconductivity in the 110-125 K range with zero-resistance in the 95-105 K range. Electron microscopic studies show dislocations, layered morphology and other interesting features. These oxides absorb electromagnetic radiation (9.11 GHz) in the superconducting phase.

Keywords. High-temperature superconductivity; $Tl_2CaBa_2Cu_2O_{8+\delta}$; Tl-Ca-Ba-Cu-O system.

PACS No. 74.70

Since the initial discovery of rare-earth-Ba-Cu-O superconductors with T_c 's in the range of 90 K, two new families of rare-earth-free cuprate systems have been found to show superconductivity in the range of 100 K. One of these is the Bi-M-Cu-O system where M = alkaline earth metal (Chu *et al* 1988; Rao *et al* 1988; Tarascon *et al* 1988), the other involving thallium. Sheng and Hermann (1988) have shown that $Tl_2Ba_2Cu_3O_{8+\delta}$ has an onset of superconductivity at 90 K with zero-resistance at 81 K. Oxides of the Tl-Ca-Ba-Cu-O system with different ratios of cations have also been discovered with zero-resistance around 100 K and onset around 120 K (Hazen *et al* 1988). We have investigated several oxides of the Tl-Ca-Ba-Cu-O and related systems and report some preliminary results in this communication.

In figure 1a, we show the X-ray diffraction pattern of a sample of $Tl_2CaBa_2Cu_2O_{8+x}$ (2122), prepared from Tl_2CO_3 , freshly prepared CaO, BaO_2 and CuO. The mixture was first heated in air for 5 minutes in a preheated furnace at 1170 K and was slowly cooled to room temperature in the furnace. The X-ray diffraction pattern clearly shows a unit cell with a *c*-parameter of ~ 30 Å. Moreover the X-ray diffraction pattern is similar to that of $Bi_2CaSr_2Cu_2O_{8+\delta}$. In table 1 we give powder X-ray data of the pure 2122 phase. Heating the 2122 phase further (after pelletizing) at 1170 K as above, leads to sharper X-ray lines but also generates some $BaCuO_2$ (figure 1b). We have found the X-ray diffraction patterns of $Tl_2Ca_2BaCu_2O_x$ (2212) to be similar to that of the 2122 sample (figure 1c); we see that some $BaCuO_2$ is present in the 2212 sample as well. The X-ray

⁺ Contribution No. 518 from the Solid State and Structural Chemistry Unit.

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