Many copper-oxide based "Thallium" compounds have now been discovered. Of these, the high temperature superconductors (HTSC) may be represented by the homologous series \((\text{Tl}_1-x\text{A}_x\text{O})_m-(\text{B}_{1-y}\text{Cy})_n\text{Ca}_p\text{Cu}_d\text{O}_{2(p+1)}+d; \) if \(A=\text{Bi}\) or \(\text{Pb}\), \(B=\text{Ba}\) or \(\text{Sr}\); \(n=2\) and \(p=1-4\). In comparison to the Bi-compounds, the Tl-system shows a richer diversity; viz., HTSC can be obtained with either one or two Tl-0 layers \((m=1,2)\); also, the triple-digit phases are easier to synthesize. The value of \(d\), the oxygen stoichiometry, is critical to achieving superconductivity. The Tl-system is robust to oxygen loss; Tl may be lost or incorporated by diffusion. We determine a diffusion coefficient equal to 10 m s at 900°C. Both ortho-rhombic and tetragonal structures are evidenced, but HTSC behavior is indifferent to the crystal symmetry. This system has the highest \(T_c\) confirmed. \(T_c\) generally increases with \(p\), the number of Cu-0 layers, but tends to saturate at \(p=3\). Zero resistance as high as 125K has been observed (1). Most of these HTSC's are hole type, but the Ce-doped specimens may be electronic.

The effort at USC has focused on the magnetic aspects; because in addition to defining the perfectly diamagnetic groundstate as in the conventional superconductors, magnetism of the copper oxides (1) show a surprising variety. This is true of both the normal and the superconducting states. Also, due to the large phonon contribution to the specific heat at the high \(T_c\), accurate thermal measurement of important parameters such as the sp. heat jump, electronic density of states, \(D(E_f)\) and coherence length are uncertain, and thus, are estimated from the magnetic results.

We determine for single phase: (i) Tl-Ba; \(D(E_f)=2.0\) states/ev.at. Cu, a BCS sp. ht. jump=6.2 mj/mol.Cu K; and (ii) Tl-(Ba,Ce); \(D(E_f)=2.2\) and a BCS sp. ht. jump=6.8 (same units). For both, the Cu moment is about 0.1-0.4 Bohr mag. The Ce moment is 1.5, representing a charge state higher than 3+. This is indicative of electron doping and is evidence for n-type behavior. Paraconductivity and diamagnetic fluctuations are consistent with the expected two-dimensionality. Flux creep shows trapping potential somewhat stronger than those in Y-123. These and other results from the Tl-system Cu-0, LaBaCu-0,120 and the Bi-Cu0 compounds will be discussed. The emphasis will be on the role of magnetism in the Tl-Cu0 HTSC, but technological aspects will also be pointed out.

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