Critical State Measurements of Superconductors and Optical Measurements of Semiconductor Samples

The transport current density dependence of the critical magnetic field of bulk polycrystalline samples of high temperature superconductors [RE]Ba2Cu3O7-x, where [RE] = Yttrium (Y), Erbium (Er), and Ytterbium (Yb), has been investigated at 77 Kelvin and 68 Kelvin. The samples were prepared using a conventional ceramic processing technique followed by sintering in a pellet form. The pellets were then cut into slabs of the appropriate size for use in a four point probe measurement. A 10-W current supply provided current densities of up to 1 A/Cm2 while a 3 Tesla magnet provided the magnetic field. The onset of the critical temperature for these samples was measured to be 90K (Y), 89K (Er), and 87K (Yb) using a standard four point probe technique in a closed cycle helium cryostat. The critical field was found to be much more current sensitive in the Y sample than in either the Er or Yb samples.

A photoluminescence study of four individually prepared samples of ZnSe has also been done in an attempt to positively identify the source of one of the features of a ZnSe luminescence spectrum. Two samples of bulk ZnSe crystals were subjected to neutron radiation, followed by an annealing at 900° C for 15 and 30 min respectively. Two other samples were epilayers grown on the (1,1,1) axis using a vapor transport method from two batches of Selenium that had each been exposed to separate levels of neutron irradiation and unradiated Zinc. An Argon-ion laser producing an ultra-violet light at 3511 Angstroms was used to excite the material, producing luminescence in the materials at 20K. A comparison of the photoluminescence spectra taken just after irradiating or growing the samples and after a half life of the Zn and Se showed a shift in intensity of the peak(s) related to the donor and acceptor transitions, while the features associated with the different lattice defects corresponding to the dopants did not change.