

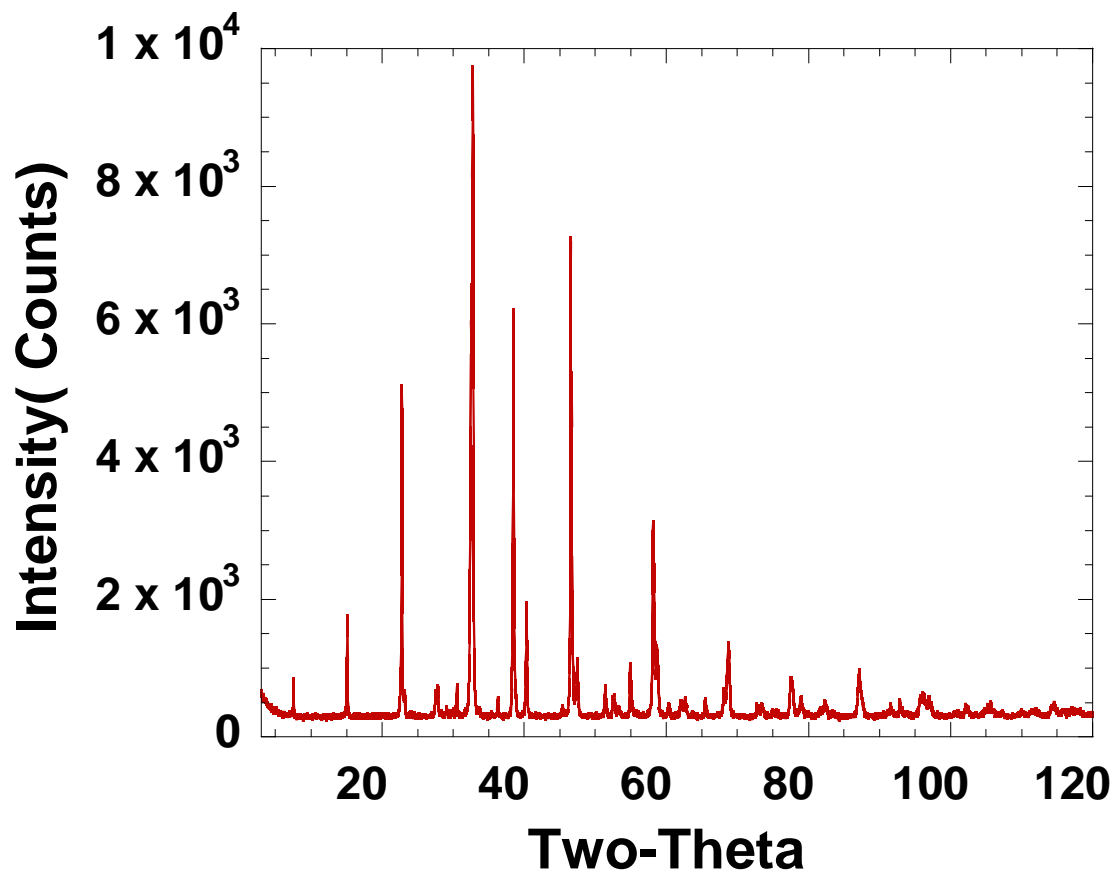
# Brief Summary of YBCO Synthesis and Characterization Workshop Activity for Summer 2011



**Fig. 1.** Students working observing (and filming) the Meissner effect on a  $\text{YBa}_2\text{Cu}_3\text{O}_{6+x}$  (YBCO) pellet during the first day of the summer research workshop. This pellet was prepared by student in the previous summer.



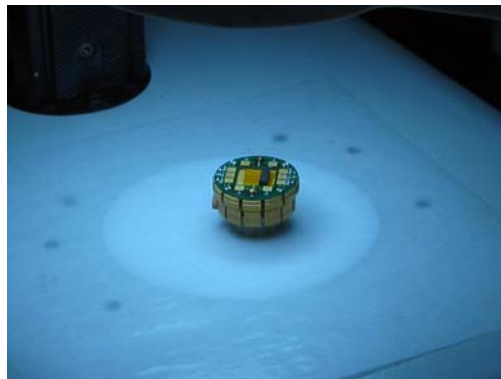
**Fig. 2.** Students weighed the starting materials ( $\text{CuO}$ ,  $\text{Y}_2\text{O}_3$  and  $\text{BaCO}_3$ ) of appropriate ratios for synthesis of YBCO (top) and mixed them (bottom) with a spatula before grinding the powder for 45 minutes in the mortar and pestle. The sample was heated to  $850^\circ\text{C}$  for  $\sim 12$  hrs. ground again for 45 minutes three consecutive times and then pressed into a small and large pellet for extensive testing. Approximately 1 week is required to prepare a sample.



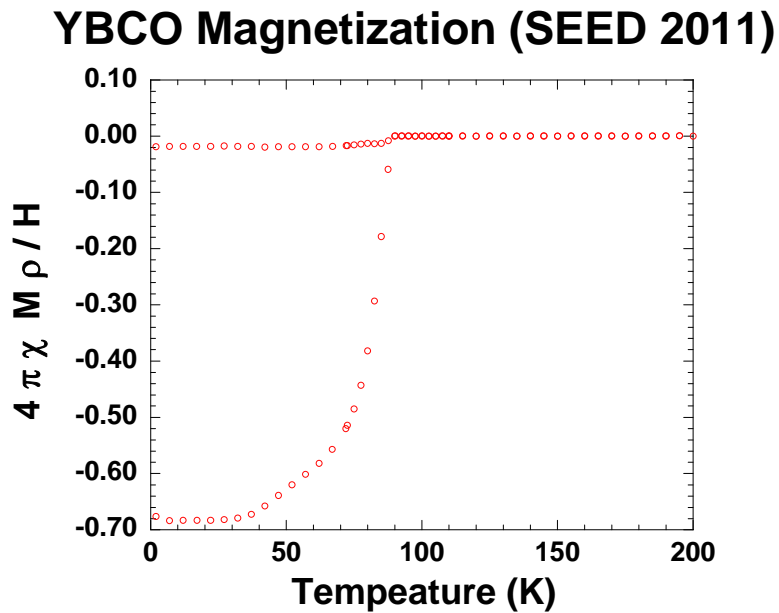
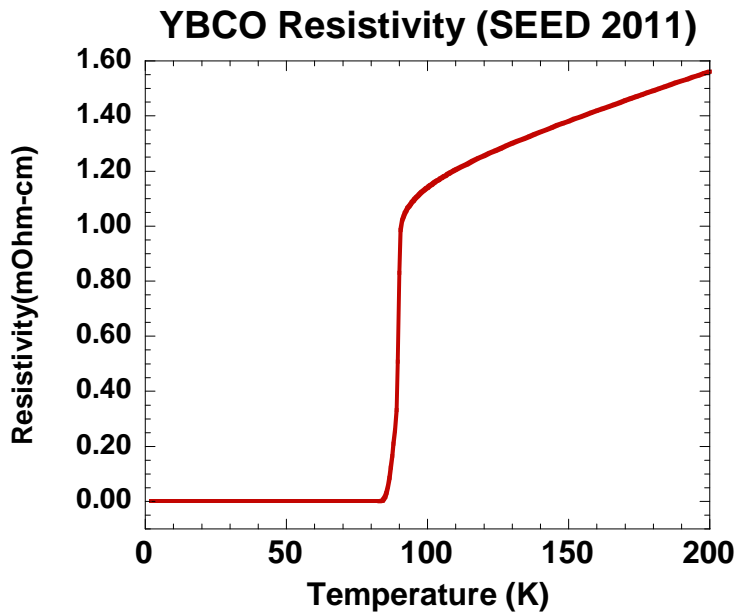
**Fig. 3.** To understand the atomic level properties, part of the YBCO sample was ground into a fine powder for x-ray diffraction measurements in our laboratory. Having been taught the fundamentals of x-ray diffraction and C language programming and installing C compilers on their computers (lcc-win), the students wrote routines to index the peaks in the pattern and also extracted the a, b and c lattice constants. The oxygen content, x, of the sample was estimated from the published x dependence of YBCO c lattice parameters.



**Fig. 4.** (top) Students here work with Mrs. Tian Yu (graduate student) to prepare their sample for magnetization measurements and with Mrs. Yu and Dr. Peng Gao to carry out the measurement.



**Fig. 5.** (Top) Israel, Ufuomaefe, and Michael preparing the YBCO sample (polishing it to a regular shape) and installing electrical contacts under the direction of Mr. Tao Wu (graduate student). (Middle) Final rectangular sample on the PPMS resistivity puck. (Bottom) Installation of the sample into the PPMS system for resistivity measurements.



**Fig. 6.** Resistivity (top) and magnetization data (bottom) for the YBCO sample, prepared by students, utilizing the NJIT PPMS system. The data were used to characterize the level of defects in the sample (resistivity) and to determine the superconducting fraction of the sample (magnetization)



**Fig. 7.** Meissner Effect test on sample (black pellet covered by liquid nitrogen) to definitively show that the sample superconducts and expels the field of the magnet causing it to float above the YBCO pellet.