Honors Seminar

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Resolving the Pseudogap in the $Y_{1-x}Pr_xBa_2Cu_3O_{7-\delta}$ system

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The mechanism underlying high-temperature superconductivity (HTS) has remained a mystery for over 30 years. One of the main reasons that HTS has remained an enigma is the complexity of competing orders within the cuprate system. These competing orders are close in energy and are dependent on doping thus any theory hoping to solve the problem of HTS is constrained by these competing orders. The obvious first step in solving the HTS problem is to tackle each of these competing orders, since describing the mechanism behind orders like the pseudogap will help us better understand the mechanism behind HTS. In this study, we focus on synthesizing polycrystalline samples of $Y_{1-x}Pr_xBa_2Cu_3O_{7-\delta}$ ($0 \leq x \leq 0.40$, $\delta \approx 0$) to better understand the mechanism behind the pseudogap in High T_c Cuprates. Analysis via X-ray diffraction confirms the nearly single-phase nature of the samples. Samples were subjected to resistance measurements over the temperature range of 10 K to 300 K. The obtained critical temperature (Tc) values align well with existing literature. Employing a linear fit method, we investigate deviations from linearity in the resistance-temperature data, particularly in the high-temperature regime, marking the onset temperature of these deviations as the pseudogap temperature (T^*). The values of T^* obtained align closely with those observed in thin film samples with analogous doping levels, as reported by our collaborators. This study culminates in an updated phase diagram delineating the influence of Praseodymium doping on the system. These findings contribute to our understanding of the pseudogap phenomenon and its manifestation in high-temperature superconductors, offering insights crucial for future research endeavors in this field.

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