Investigating Doping and Structural Transitions in TaCrP to Create a Novel Superconductor

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This project aimed to produce a Type II superconductor through substitution doping of Zirconium (Zr) into the crystalline structure of Tantalum Chromium Phosphorus (TaCrP), which has never been done before. Research focused on TaCrP due to its TiNiSi-type structure, one known for type II superconductive materials because of its orthorhombic crystal structure, and high electronic instability. This investigation produced distinct TaCrP samples doped with varying percentages of Zr through solid-state reaction and arc-melting. This project took XRD patterns and measured the magnetic moment of the samples at varied temperatures close to absolute zero to research their crystalline structure. This project did not yield a novel superconductor; however, it did discover distinct structural phase shifts due to Zr doping and subsequent modification of the density of states at the Fermi level. This demonstrates that TaCrP is tunable and has a strongly correlated electron system, a major field in Physics. This research can be continued to potentially create a novel superconductor through further sample purification and doping, especially since this project demonstrates the profound effect that substitution doping has on the crystalline structure and stability of TaCrP. Superconductors power technology such as quantum computing, MRI machines, and lossless energy transmission. Thus, producing superconductors that function at higher temperatures would be revolutionary for science and technology, therefore motivating this project.

Awards Won: