

**Stony Brook University  
The Graduate School**

Doctoral Defense Announcement

**Abstract**

**Phase separation and neighboring ground states of superconductivity in  $K_xFe_{2-y}Se_2$**

By

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Iron-based superconductor  $K_xFe_{2-y}Se_2$  has generated considerable attention having higher critical temperature ( $\sim 32$  K)<sup>1</sup> than previously reported FeSe series ( $\sim 8$  K) by intercalating K and showing a unique phase separation with Fe vacancy order. We investigate the effect of the chemical substitution to the ground state and report various ground states such as spin glass phase and superconductor-insulator transition (SIT) under high-magnetic field by substitution of Na, Te, and Ni on  $K_xFe_{2-y}Se_2$  single crystal.

The normal-state in-plane resistivity below  $T_c$  and the upper critical field  $\mu_0H_{c2}(T)$  for  $K_xFe_{2-y}Se_{1.85}Te_{0.15}$  and  $K_{0.50}Na_{0.24}Fe_{2-y}Se_2$  are measured by suppressing superconductivity in pulsed magnetic fields. The normal-state resistivity  $\rho_{ab}$  is found to increase logarithmically as  $T/T_c \rightarrow 0$  with decreasing temperature similar to granular superconductors and Cu-based high- $T_c$  superconductors. Our results suggest that SIT may be induced in high magnetic fields, which is related to the intrinsic real space phase separated states. We also present a ground state change of  $K_xFe_{2-\delta-y}Ni_ySe_2$  ( $0.06 \leq y \leq 1.44$ ) single crystal alloys. Small amount of Ni ( $\sim 4\%$ ) substitution suppresses superconductivity below 1.8 K and for higher Ni content insulating spin glass magnetic ground state is induced.

<sup>1</sup>. Guo J G, Jin S F, Wang G, Wang S C, Zhu K X, Zhou T T, He M and Chen X L, Phys. Rev. B 82 180520 (R) (2010)

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