Research on preparation and magnetic flux pinning mechanism of $Fe_ySe_xTe_{1-x}$ superconducting films

Jia-Ying Zhang[1], Ya-Xun He[1], Jun-Yi Ge[1,*]

[1] *Materials Genome Institute, Shanghai University, 200444 Shanghai, China*

The 11-type $Fe_ySe_xTe_{1-x}$ (FeSeTe) superconductors behave the ultra-high upper critical magnetic field (H_{c2}) and the high critical current density (J_c), making them ideal candidates for high-field applications. Since the magnetic flux pinning is a decisive factor affecting the superconductivity under high fields, it is necessary to clarify its pinning mechanism. Here, various defects were introduced as the pinning centers by changing the composition and preparation parameters using the pulsed laser deposition. The evolution of J_c and pinning force density with temperature and magnetic field of $Fe_ySe_xTe_{1-x}$ films were systematically studied by the electrical and magnetic measurement, microstructure analysis and numerical simulation. It can be found that changing the substrate temperature and composition can effectively tune the flux pinning type of the $Fe_ySe_xTe_{1-x}$ films, and Fe content is found to be a key factor affecting the critical temperature (T_c) and magnetic flux pinning. Finally, the substrate temperature (T_s) -T_c phase diagram and ternary-component T_c phase diagram of $Fe_ySe_xTe_{1-x}$ films have been constructed, which provide guidance for the performance improvement and high-field applications of FeSeTe coated conductors.

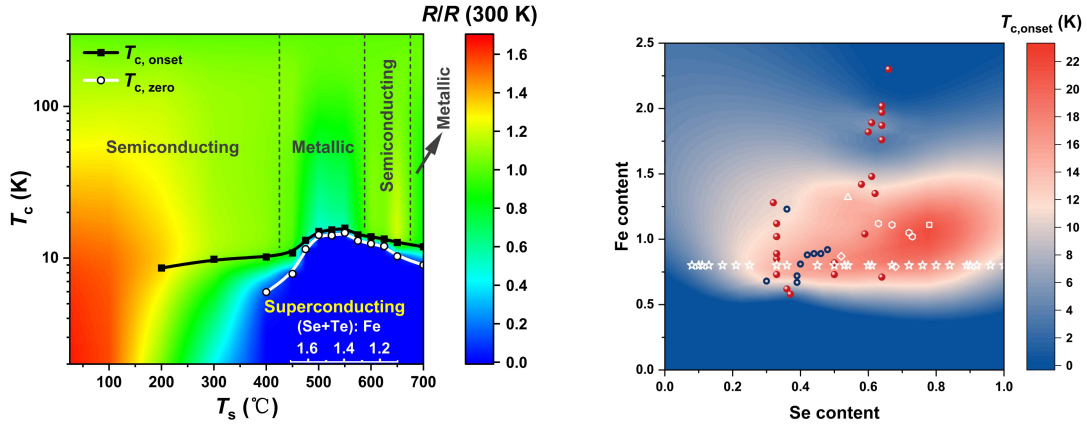

Figure. (Left) Phase diagram of normalized resistance as a functions of substrate temperature. (Right) T_c phase diagram for $Fe_ySe_xTe_{1-x}$ superconducting films grown on the CaF_2 substrate by pulsed laser deposition

References

[1] J. Zhang *et al*., *Supercond. Sci. Technol.* **37**, 055007 (2024).
[2] J. Zhang *et al*., *Supercond. Sci. Technol.* **36**, 125009 (2023).