Ion Irradiation to $FeSe_{0.5}Te_{0.5}$ Superconducting Films

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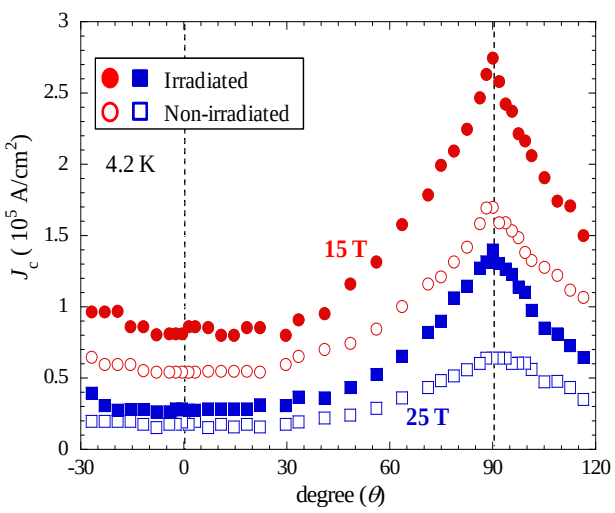
Introduction

Among iron-based superconductors, the so-called '11' system $Fe_{1+x}Se_yTe_{1-y}$ (FST) has several practical advantages over the pnictide. We have made superconducting (FST) films by pulsed laser deposition (PLD). Our FST thin films exhibit a superconducting transition (T_c) at as high as 21 K, which is much higher than that of bulk, ~ 15 K. Our films are able to hold critical current density (J_c) as high as 1 MA/cm^2 in self-field and 0.1 MA/cm^2 under 35 T. Here we introduce new pinning mechanism by ion irradiation to see if we can further increase the J_c of our FST films.

Experimental

We have grown epitaxial $FeSe_{0.5}Te_{0.5}$ thin films on single crystal substrate with CeO_2 buffer layer using pulsed laser deposition (PLD). We have used ion irradiation to introduce new pinning centers in our FST films. We irradiated one half of the sample, leaving the other as a reference and measure them together at Cell 12.



Results and Discussion

The ion irradiation improved the J_c over a wide field range without T_c degradation.

Fig. 1 shows $J_c(\theta)$ curves measured at 4.2 K. J_c of irradiated film increases for all orientations with respect to the J_c of non-irradiated film. The previous study on pnictide thin films, such as Co-doped $BaFe_2As_2$ films exhibited that the irradiation caused the degradation of both T_c and J_c. However, our results suggest that the ion irradiation enhance J_c in FST films without T_c degradation.

Conclusions

We have irradiated ions into FST films. The ion irradiation improved the superconducting performance of the FST thin films. Our results indicate that ion irradiation is very promising for producing new pinning centers in iron chalcogenide films for high magnetic applications.

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References

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