5 - 8 Effect of Ti Addition on Microstructural Evolution, Strengthening and High Thermal Conductivity Mechanisms of FeCrV-based Medium-entropy Alloys

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Our previous study has found that $FeCrVTi_x$ medium-entropy alloys (MEAs) with BCC matrix and Laves precipitation have high yield strength (1 097∼1 493 MPa), good fracture strain (27.1%∼47.7%) and excellent thermal conductivity (42.2∼69.7 W/(m·K) at 673∼1 273 K), it is expected to be widely applied in the fields of advanced nuclear energy and aerospace[1]. However, what is the mechanism of strengthening and high thermal conductivity of this MEAs?

In the current work, according to the experimental results and theoretical calculations, a mixed-strengthening-mechanism model dominated by precipitation and fine-grain strengthening has been proposed, it can well explain the increase in yield strength of FeCrV-based MEAs due to Ti-added[2]. Meanwhile, the Laves-phase precipitation formed by adding Ti improves the compressive plastic deformation through grain refinement, crack bridging and crack deflection. Moreover, the high thermal conductivity of $FeCrVTi_x$ MEAs is primarily due to the inelastic scattering of phonons and electrons in the medium/high-temperature regions. Based on the above mechanisms (Fig. 1), the mechanical and thermal properties of MEAs/HEAs can be regulated in the pre-design and post-treatment stages, which provide new ideas and methods for the design and performance-optimization of high-performance structural materials. Our work not only provides successful demonstrations to study the strengthening and high thermal conductivity mechanisms of MEAs/HEAs, but also accelerates research and development of MEA/HEA systems with outstanding properties.

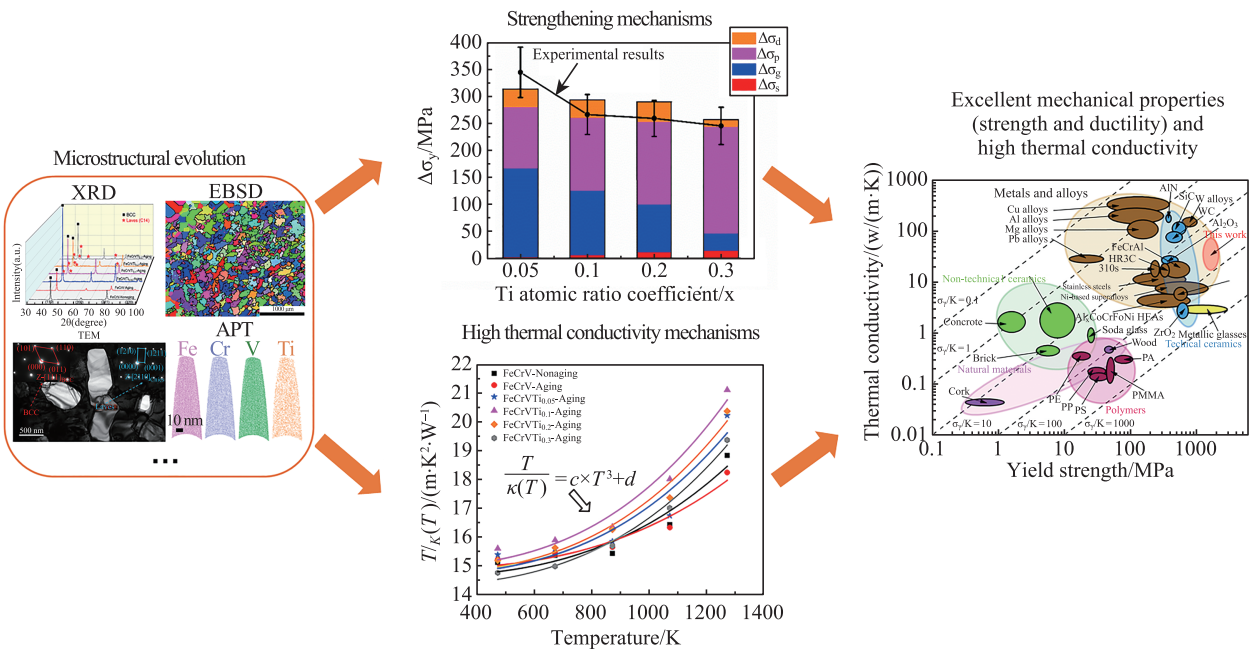

Fig. 1 (color online) Microstructural evolution, strengthening and high thermal conductivity mechanisms of $FeCrVTi_x$ MEAs.

References

[1] J. H. Cui, Z. Y. Cheng, D. Chen, et al., Journal of Alloys and Compounds, 894(2021)162398.

[2] Z. Y. Cheng, J. H. Cui, D. Chen, et al., Materials Science and Engineering: A, 870(2023)144858.