Laser Processing Properties of Tungsten-Rhenium Alloy and Potassium-doped Tungsten

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The materials in the area of the divertor in fusion reactors are exposed to extremely high thermal loads from plasma bombardment and neutron radiation. Numerous studies have shown that tungsten (W)-based materials are considered as candidates for divertors. Generally, laser surface treatment is considered to be a promising method to construct micro-nano structures, which is widely used to enhance the performance of W-based materials under extreme conditions [1]. The laser processing properties of tungsten-rhenium (W-Re) alloys with enhanced mechanical properties as promising candidate materials for nuclear fusion reactors have been reported by us [2]. In addition, K-doped W has excellent thermal shock resistance, the recrystallization temperature (RCT) is almost doubled compared with pure tungsten, and the ductile-brittle transition temperature (DBTT) can still be as low as 150~200°C, which gives it a much lower DBTT than other dispersion-strengthened phase W-based materials when improving RCT. In addition, K-doped W has lower manufacturing cost than W-Re alloy. However, there is still a lack of reports on the laser processing properties of K-doped W.

In this work, we demonstrated the first results on the laser processing properties of K-doped W, and compared them with pure W and W-Re alloys. A nanosecond Nd:YAG visible laser system was employed as a light source for laser processing. The ablation properties of all samples are shown in Fig. 1. K-doped W has almost the same ablation threshold as pure W, but has a comparable ablation depth to highly doped W-Re alloy. These results show that K-doped W are easier to achieve laser ablation, and more complex micro-nano structures can be fabricated with lower costs. A more detailed report will be presented at the conference.

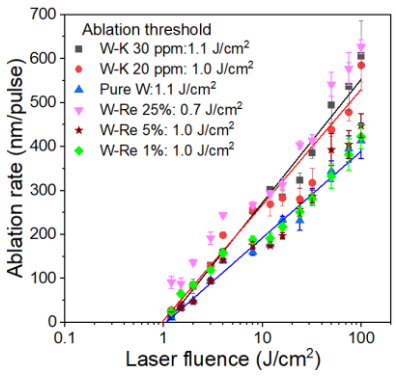

Fig. 1. Laser ablation properties of tungsten, W-Re alloys and K-doped W

References

[1] K. E. Hazzan, et al., Micromachines, 12(895), 2021.

[2] H. Yang et al., Journal of Laser Micro/nanoengineering 17(3), 2022.