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**Advanced Tungsten Based Materials for Plasma Facing Components**

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Tungsten (W) will be used as plasma facing material (PFM) in fusion reactors after ITER. However, in order to maintain the integrity of the material even during long-term operation under high heat loads, it is necessary to overcome issues such as the low temperature brittleness and recrystallization embrittlement of W. To overcome these issues, the development of modified W based materials has been promoted in Japan using a powder metallurgy technology in cooperation with universities, national institutes, and companies. The main methods applied for the modification were the second phase dispersion and solid solution alloying, which involved the control of grains and grain boundary characteristics. In particular, the effects of doping with potassium bubbles (K-doping) and lanthanum (La) oxide particles, and alloying with rhenium (Re) and tantalum (Ta) were evaluated. As a result, the ductile-to-brittle transition temperature (DBTT), recrystallization resistance, and resistance to high heat flux (HHF), which might be the dominant factors for the operating temperature range and lifetime of plasma facing components (PFCs), were improved compared to pure W, and a certain effect was successfully observed.

Even in the modified W based materials that have been improved through the above-mentioned methods, most DBTT is still higher than room temperature. Considering the maintenance of PFCs during the operation period and the increase in DBTT caused by neutron irradiation, further improvement is desirable. As one candidate solution, W matrix composites reinforced with W wires (Wf/W composites) is being developed. A.L.M.T. Corp. has been providing W narrow wires as mass-produced products for many years. It has also been shown that the recrystallization resistance and strength of W wires can be improved by K-doping. Possibility of application of the W narrow wires to composite materials will be presented in this talk.

In addition to the above-mentioned development of monolithic and composite materials, recent progress on the development for future fusion, e.g., advanced W powders for additive manufacturing (AM) and W based materials for radiation shielding, will be presented.

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