

## §23. Development and Synthetic Evaluation of High-Z Plasma Facing Materials

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Tungsten (W) and its alloys, are very promising for use as PFM and PFC. However, they exhibit significant embrittlement, in several regimes; i.e., low temperature embrittlement, recrystallization embrittlement, radiation embrittlement and helium embrittlement. In addition, data on the physical and mechanical properties required for the use of W and its alloys as PMC/PFC are very limited. Therefore, a LHD research project entitled "Development and synthetic evaluation of high-Z plasma facing materials" was performed for three years from 2001, by an organized research group consisting of PSI and materials researchers from universities, NIFS, JAERI and private corporations. After that research activities related to the project are still being continued by each member of the group.

The following meeting was held on February 7, 2005 at NIFS in order to report the main results obtained through the three-year LHD project and discuss the future task. Approximately 20 members got together. After the meeting, a LHD tour was also offered. The program of the meeting was as follows:

9:00-9:05	Opening	H. Kurishita (Tohoku Univ.)
9:05-9:45	Features and issues of W for fusion reactor applications	N. Yoshida (Kyushu Univ.)
9:45-10:10	Development of ductile W alloys with ultra-fine grains and nano-sized dispersoids	H. Kurishita
10:10-10:35	Surface modification of refractory metals by multi-step nitriding	M. Nagae (Okayama Univ.)
10:35-10:55	Fundamental study on plastic working of tungsten based on its superplastic deformation	T. Kurumada (Ibaraki Univ.)

10:55-11:20	Study on irradiation by mixed beams of hydrogen and carbon to W	Y. Ueda (Osaka Univ.)
11:20-11:45	High heat and particle loading on W materials	K. Tokunaga (Kyushu Univ.)
11:45-12:10	Deuteron irradiation effects for tungsten and its alloys	H. Iwakiri (Kyushu Univ.)
12:10-13:00	Lunch	
13:00-13:25	Effects of microstructures in tungsten on solid-state reaction rate of amorphous carbon films with bulk tungsten	Y. Hatano (Toyama Univ.)
13:25-13:50	Joining of bulk tungsten with oxygen free copper and high heat loading of joined specimens	Y. Imamura (Ibaraki Univ.)
13:50-14:15	Mechanical property changes and surface damage in tungsten irradiated with light ions	A. Hasegawa (Tohoku Univ.)
14:15-14:40	Effects of neutron irradiation on microstructures and hardness of pure W and W-0.3wt%TiC	S. Kobayashi (Ehime Univ.)
14:40-15:05	Deformation and fracture of pure tungsten	Y. Hiraoka (Okayama Sci. Univ.)
15:05-15:25	Mechanical properties of W materials at very high temperatures	K. Tanoue
15:25-15:45	Fracture toughness of Mo alloys with elongated grain structures	T. Igarashi ((Ion Eng. Co.)
15:45-16:15	Discussion	
16:15-16:25	Summary and closing	N. Noda (NIFS)

These presentations showed that significant progress was achieved concerning ductile W alloy development, W surface modification, plastic working, joining technology and fundamental properties of several commercially available W alloys; the scope of the project included radiation effects, heat/particle loading, solid-state reaction, low and high temperature mechanical properties. The discussion made was also very useful.

This project will be continued in 2005 as a new NIFS subject "Synthetic evaluation of ultra-fine grained W alloys as PFC materials"