Preface to the special issue: applications of tungsten materials

Yu-Cheng Wu^{1,2}

© The Nonferrous Metals Society of China 2019

Tungsten (W) and its alloys/compounds possesses several proprietary features, which are applied widely in the fields of defense and military, aerospace, electronic industry, radiation shield, machining, photoelectricity, catalytic and energy, etc. Topics in this special issue contain six contributions with two review papers and four research articles, covering plasma facing materials (PFMs) of W materials in fusion engineering, hardmetals of tungsten carbide (WC)-based composites in machining and electrochromic functional materials of tungsten oxide (WO₃) in smart materials.

W materials act as the promising PFMs in the nuclear fusion reactor because of its decisive advantages of the high melting point, excellent thermal conductivity, good high-temperature strength, high sputtering threshold and low tritium retention. In view of the operation conditions of W materials, a review paper (Tao Zhang, et al.) on the thermal stability of dispersion strengthened tungsten is given by evaluating their recrystallization temperature and the corresponding hardness evolutions. An in situ observation on the He-ion irradiation effect on the W–TiC composite was performed in an ion-accelerator-transmission electron microscope (TEM) technology (Q. Xu, et al.). And, the dual effects from the thermal shock and He-ion irradiation on the W–TiC composite were analyzed by scanning electron microscope (SEM)-focused ion beam (FIB) and TEM-FIB characterizations (Yu-Cheng Wu, et al.), which presented some novel behaviors of He bubbles under certain conditions. Furthermore, an improved chemical method was applied successfully to produce nano-sized W–Y₂O₃ composite powder, and the phase interface of W/Y₂O₃ was rarely reported (Zongqing Ma, et al.).

Hardmetals with high hardness, superior abrasive resistance, high mechanical strength, and decent elasticity modulus are considered as the “tooth” of the industry, have become the main product of W consumption since 2017. The manufacturing technology of WC–Co hardmetals was roundly reviewed from the powder preparation, bulk densification, performance characterization and its development (Hongbo Nie, et al.). On the other hand, the distinct band structure and variable valence states of tungsten oxide make it a versatile functional material for energy-efficient applications, such as electrochromic WO₃ thin films for smart windows (Yong Zhang, et al.).

Actually, the contributions in this special issue only present parts of applications for W-based materials, and more contributions are expected in the journal *Tungsten* by scientists in related fields. I hope that these topics could provide a comprehensive insight into the application, the manufacturing technology, microstructure characterization and innovative ideas for promoting the development of W-based materials. Meanwhile, I would like to sincerely thank all the authors for their great efforts in preparing the high-quality manuscripts and the expert reviewers for providing constructive comments and helpful suggestions, which contribute substantially to the high scientific level of this issue. I also thank the efficient and professional editorial office of *Tungsten* for their efforts to make this issue such a great success.

Yu-Cheng Wu

✉ Yu-Cheng Wu
ycwu@hfut.edu.cn

Yu-Cheng Wu
Sep 15, 2019

¹ National-Local Joint Engineering Research Centre of Nonferrous Metals and Processing Technology, Hefei University of Technology, Hefei 23009, China

² Key Laboratory of Interface Science and Engineering of New Materials, Ministry of Education, Taiyuan University of Technology, Taiyuan 030024, China

Yu-Cheng Wu is a full professor of Materials Science in both Taiyuan University of Technology (TYUT) and Hefei University of Technology (HFUT). He received his Ph.D degree at Institute of Solid State Physics, Chinese Academy of Sciences in 2000. Then he worked as Senior Visiting Scholar at University of Stuttgart in 2001–2002. Prof. Wu's current research interests include fusion materials, energy materials, metal matrix

composites. In recent years, he presided over than 30 projects of National Major Basic Research ITER Project, Natural Science Foundation and Major Science and Technology Research Projects of Ministry of Education of China, etc. He has published over 300 peer-reviewed papers in journals including *Science Advances*, *Nuclear Fusion*, *Advanced Materials*, *ACS Nano* and so on.