TUNGSTEN – Properties, possible and impossible applications

Tungsten is an extreme material. Of all metals it has, for example, the highest melting point, the lowest thermal expansion coefficient and the lowest vapour pressure. But tungsten has significant drawbacks which prevent its use for typical structural applications. With the advance of nuclear fusion technology the need for exceptional high heat flux components arose. And therefore, many generic designs of cooling components have been proposed which make extensive use of tungsten as armor, but also as structural material.

This presentation gives an overview of the basic properties of tungsten, its typical use, consumption and resources. Commercial production routes and processing techniques are discussed with the focus on material properties and application. It will be shown that tungsten cannot be easily used for cooling structures or other structural applications. Especially in a nuclear fusion environment, many different aspects become relevant at the same time. Taking these into account together with the special material properties leads to a set of design rules which have to be applied to tungsten, if it had to be used as a structural material. To illustrate some of the worst problems, three different helium cooled divertor designs are analyzed and assessed. Finally, an outlook on recent developments of tungsten composites and their advantage over standard bulk tungsten is given.

Short CV

Michael Rieth works as senior research scientist at the Institute of Applied Materials (IAM) at KIT, the Karlsruhe Institute of Technology, Germany, since 2002. He worked as a researcher at the Institute of Materials Research II in the Forschungszentrum Karlsruhe from 1995 to 1999 and at the Engineering Science Department of the University of Patras, Greece, from 1999 to 2000. Dr. Rieth was the editor-in-chief of the *Journal of Computational and Theoretical Nanoscience* from 2004 to 2005. He is the author of *Nano-Engineering in Science and Technology* (World Scientific, Singapore, 2003) and he is editor of the *Handbook of Theoretical and Computational Nanotechnology* (American Scientific Publishers, Stevenson Ranch, 2006). His main scientific interests are in materials development for advanced nuclear applications as well as modeling of metallic materials and nanosystems. Since 2008 he is co-chairing the EFDA Topical Group on Fusion Materials and acts as Work Package Leader in the European GETMAT programme. He also gives lectures in materials science at KIT and at the Baden-Wuerttemberg Cooperative State University (Duale Hochschule).