

## **Review report of the dissertation thesis**

Thesis title: *Thermal stability of tungsten alloys*

Study program: *Application of Natural Sciences*

Branch of study: *Physical Engineering*

Specialization: *Structure and Properties of Materials*

Author of the thesis: *Ing. Jakub Veverka*

Training workplace: *Institute of Materials and Machine Mechanics of the Slovak Academy of Sciences*

Supervisor: *Ing. Ondřej Kovařík, Ph.D.*

Supervisor-Specialist: *Ing. Monika Vilémová, Ph.D.*

Reviewer: *prof. Ing. Pavel Novák, Ph.D.*

Reviewer's workplace: University of Chemistry and Technology Prague, Department of metals and corrosion engineering

### **1. Actuality of the chosen topic:**

Due to the importance of nuclear energy in the energy mix of our country, the investigation of materials for nuclear power plants is of very high importance. Especially, the powder metallurgy use is very promising and eco- and energy-friendly way of their production.

### **2. Selected methods of dissertation thesis processing:**

The thesis was written as the commented collection of four papers. In the case of three of them, the Ph.D. candidate is the first author. The papers are co-authored by the researchers from Institute of Plasma Physics of ASCR, Czech Technical University and also other institutions in our country and abroad (in Poland).

The majority of the commenting text is the general introduction, describing the fundamentals of nuclear fusion, materials for nuclear power plants, tungsten alloys and spark plasma sintering method. In addition, each paper is commented on one page. What I miss in the thesis, is the exact description of the exact role of the author of the thesis on these papers.

The commented papers deal with the description of the effect of carbon and oxygen on the properties of tungsten, development and characterization of W-Cr alloys (in fact the in-situ composites formed by the decomposition of the solid solution), which are expected to have better oxidation resistance than W-Si. The alloys were prepared by spark plasma sintering (also called "field assisted sintering") and characterized from the viewpoints of microstructure, phase composition and mechanical properties. The fourth paper also includes modelling of the decomposition of the W-Cr solid solution.

### **3. Achieved results:**

The main results of the thesis are the description of the behaviour of impurities (carbon and oxygen) during spark plasma sintering. The best results were achieved by sintering in

vacuum. The decomposition of the Cr-W solid solution was described and it was shown that it can lead to the nanostructured in-situ composite.

#### **4. Benefits for the further development of science and technology:**

The results of the work will be undoubtedly welcomed in the development and design of nuclear power plants. In addition, they can influence the scientist to think about Cr-W based materials also for other possible applications.

#### **5. Fulfilling the aims of the thesis:**

All declared aims of the thesis were fulfilled without reservations.

#### **Questions and comments:**

1. What is the exact role of the author of the thesis on the commented papers?
2. On page 21 it is mentioned that the nuclear fusion will be environmentally friendly source of energy. Just below it is stated that lithium needs to be mined and used. Is it really so eco-friendly? Moreover, lithium is needed also for other "eco" solutions (batteries).
3. What is meant by "oxygen reduction" on page 43?
4. On page 45, "hammering" probably means "forging". It is needed to use proper terminology.
5. In the first commented paper on page 9, the TGA curves are decreasing for the samples with carbon. Why did it happen, when the TGA was carried out in He atmosphere?

Submitted dissertation of Ing. Jakub Veverka on the topic "*Thermal stability of tungsten alloys*" meets the conditions set for doctoral dissertation theses, therefore I recommend the work for defence and propose the award of the academic title "PhD.".

Prague 12/04/2023

  
*prof/Ing. Pavel Novák, Ph.D.*