



Prof. Aivaras Kareiva
Department of Inorganic Chemistry
Faculty of Chemistry and
Geosciences
Vilnius University

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Prof. RNDr. Jiří Mosinger, Ph.D.
Head of the habilitation commission
Research Support Department
Faculty of Science
Charles University
Albertov 6, 128 43 Praha 2
Czech Republic

**Report on the habilitation thesis “Non-conventional synthesis
and processing in the front-end of the nuclear fuel cycle”
submitted by RNDr. Václav Tyrpekl, Ph.D.**

The habilitation thesis presents a series of investigations on the development of nuclear fuel cycles for both industrial and research fuels. Fabrication using precipitation techniques and characterization of different nuclear fuel oxide systems (U^{4+} , Th^{4+} , U^{6+}), new technological approaches the powders to be compacted and densified into fuel pellets, are suggested. The powders densification processes using electrical field assisted sintering techniques, in particular spark plasma sintering, have been developed by the applicant. In the past decades the development of these techniques showed that related technologies are key advanced technologies, which enable to show different outstanding physical properties of nuclear fuel. The discovery of new advanced possibilities in the ^{232}Th - ^{233}U oxide systems with multiple superior qualities for nuclear fuel remains an important problem and important tasks for scientists. In this habilitation thesis, the main emphasis was focused on the improvement of UO_2 , ThO_2 , UC, doped UO_2 powder preparation and properties, on the oxalate derived ThO_2 powders and its sintering performance, on the studies of the recycling of ThO_2 pellet scrap and advantages of spark plasma sintering of UO_2 , ThO_2 , UC powders. In this regard, the habilitation thesis contains new, original and very important results.

The habilitation thesis is very well written. I would like to stress on a very comprehensive and valuable Introduction part with literature review which covers all aspects of the nuclear power field starting from the history of active nuclear power industry and the nuclear electricity production in the world, introducing to fuel lifetime or “nuclear fuel cycle”, comparison of applicability of two main oxides UO_2 , ThO_2 as fuels for the production of nuclear energy, and finishing with the discussions of the peculiarities of nuclear fuel production.

Naugarduko 24
LT-03225 Vilnius, Lithuania

Tel.: 370-5-2193110
E-mail: aivaras.kareiva@chgf.vu.lt

Of special interest is the preparation of fuel oxide compounds. It is well-known that the preparative chemistry of these oxides can be very complex. Therefore, the presented thesis discusses research works dealing with the nonconventional front-end of the nuclear fuel cycle. The investigation of oxalates as important salts in the technology of uranium and thorium fuel production is the leading motive of current habilitation thesis. The development of preparative techniques for the rapid and accurate synthesis of the inorganic compounds, i.e. determination of exact phase composition, surface morphology and physico-chemical behaviour is very important scientific task for inorganic and materials chemists. The low-cost and robust technique for the preparation of nanocrystalline UO_2 and ThO_2 with desired grain size and purity was developed by the applicant. The methodologies, which found useful applications practically all across modern solid state chemistry have led to the establishment of new chemical methods.

Do not repeating the details of the research which are adequately described in high quality publications and summarized in the habilitation thesis I would like to state that the results which have been summarized in 18 articles and published in peer-reviewed international journals confirm significant contribution by the author in the field of his research activity. The collaborative aspect of the research projects has increased scientific level of habilitation thesis significantly. The results obtained by the applicant fulfilled the qualitative and quantitative requirements set for scientific research. This work does not have any serious flaw. The significance, novelty, and potential impact were described in the thesis. The results summarized indicate that the author have managed to utilize the knowledge and experience collected during several years working at Charles University, Belgian National Nuclear Research Centre and Joint Research Centre in Karlsruhe. The results presented in the habilitation thesis of Dr. Václav Tyrpekl are an opening of a new view within nuclear materials chemistry. The materials are being synthesized and investigated in unique manner, apparently for the first time. These materials are expected to have an additional impact wherever such ceramics could be used in many more applications.

A PhD in the relevant subject field Dr. Václav Tyrpekl holds (2011-2012) from the Charles University in Prague and University of Strasbourg. The quality and quantity of scientific production are suitable for the Full Professorship. In the referred database of Web of Science for Dr. Václav Tyrpekl more than 50 publications in high level international journals were listed. The quality of this research outcome is very good. Dr. Václav Tyrpekl's research work is strongly focused on the advanced materials and the development of high-technology processes. Dr. Václav Tyrpekl has a very good national and international dissemination of the research results. He has developed a network of contacts in both industry and academia. Dr. Václav Tyrpekl shows very promising potential to stimulate and develop research in the subject. The priority, probably, will be in the research of materials technology and developing of new sustainable technologies for the preparation of new materials as well as environmental application of novel technologies. Dr. Václav Tyrpekl has an experience of different teaching forms and pedagogical theories and methods, and has a very strong and rather broad background in chemistry and materials science. This is well suited for this teaching position at Charles University. Dr. Václav Tyrpekl looks, in my opinion, like an experienced academic teacher.

In summary, Dr. Václav Tyrpekl has a very good research track record, and he possesses the suitable scientific and research background, also being a dedicated teacher. I find the habilitation work performed by Dr. Václav Tyrpekl interesting and well-reasoned. The

results and conclusions of the work are presented in a clear and scientific manner. His ability to contribute new ideas and expertise to impart nanostructure and texture in bulk materials, ability to develop a detailed research plan and potential for further significant contributions to his field of research are beyond doubt. His experience in advanced materials characterization techniques is outstanding. The habilitation thesis is a valuable contribution to the field and Dr. Václav Tyrpekl deserves to be awarded the degree of Habilitate Doctor.

Prof. Aivaras Kareiva
Dean of Faculty of Chemistry and Geosciences
Vilnius University