



August 31, 2015

Vedecká rada Fakulty jaderné a fyzikálně inženýrské ČVUT

Vec: Posudek habilitační práce - Dr. Mojmir Nemec: Příprava vzorku pro urychlovacovou hmotnostní spektrometrii

General comments:

The presented work details the author's novel contributions to sample preparation techniques for Accelerator Mass Spectrometry (AMS), which are very appropriately put in context of the current state of the field.

AMS is currently one of the most sensitive analytical applications and has shown great promise in measurements of ultratrace quantities of isotopes of many chemical elements. This field is therefore at the forefront of science innovation and its significance proves the author's contributions to be greatly important. Through this synthesis the author demonstrated a great understanding of the principles and applications of this method and thanks to his presented publications established himself among the experts in sample preparation for AMS. This work also provides a valuable literature resource on AMS in Czech language for students and colleagues in the field.

The author discussed the applicability of AMS for the analysis of selected individual isotopes. Special emphasis was put on C-14 determination in wooden samples in which the author made significant contribution through introduction of innovative sample processing and preparation methods. The objective of these methods is to refine the samples to remove the more labile and potentially "contaminated" fractions of wood. The author tested three wood processing methods in which he adapted and improved procedures from other chemical disciplines and demonstrated their applicability for a successful isolation of holocellulose and alphacellulose. The analysis of samples processed with these methods resulted in highly refined ages and matched the reference material ages very well.

Another important novel contribution was the optimization of graphitization of carbon samples appropriate for AMS analysis. The author first gave an overview of graphitization methods in various settings. Carbon dioxide reduction via hydrogen on iron surfaces was used at LIP ETH but there were problems with the reproducibility and length of the process. The author worked directly with LIP ETH to optimize their graphitization procedure followed by AMS measurements on MICADAS. During his postdoctoral studies the author directly contributed to a development of the prototype of an automated graphitization instrument (AGE-1) and corresponding software (graphical user interface). Its parts and their function are also detailed in this work. The latest version AGE-3, which is now commercially available was developed based on AGE-1. This is yet another example of the importance of this work.

Another AMS application to which the author contributed and is discussed in this work is the determination of U-236. This isotope has extremely low natural abundance but is also produced in nuclear reactors and during nuclear explosions. This results in



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highly variable distribution in the environment and problems with sample contamination. The most common methods of U separation are time-consuming requiring significant volumes of samples (e.g. seawater) and chemicals. The objective of the presented work was to develop an efficient and fast separation technique and eliminate high background levels of U throughout the separation procedure. A previously developed TiO-PAN material was tested and its background U-236 levels were significantly improved to acceptable levels for AMS applications. Moreover, this work continues as a dissertation project supervised by the author on the development of low U target materials.

Through this work the author presented his contribution to the field of AMS sample preparation. It is clear that Dr. Nemec is at the forefront of experts on sample preparation techniques and is a great asset to the scientific community. The author is praised for his clear presentation of the topic and novel contributions.

Recommendation:

Dr. Nemec's contribution is of great significance to the field of AMS and the presented work is more than satisfactory for the requirements for the academic rank "docent" at the Faculty of Nuclear Science and Physical Engineering, Czech Technical University. I fully support his nomination for the rank "docent". Please, do not hesitate to contact me should you have any questions about my review.

Sincerely,

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