

FINAL REPORT

on the implementation of project AKTION No. 95p2 – Corrosion processes in mixed sintered materials

Basic information:

Commencement of project implementation: January 1, 2023

Project completion: December 31, 2023

Project partners:

TU Wien – Assoc. Prof. Dr. Günter Fafilek, Vienna University of Technology, Institute of Chemical Technologies and Analytics

Brno University of Technology (BUT) – Assoc. Prof. Ing. Marie Sedlaříková, CSc., Brno University of Technology, Institute of Electrotechnology

Academic stays of Brno University of Technology staff at TU Wien

1. Purpose and Venue of the Trip: TU WIEN – discussions within the framework of the AKTION project, publication

Participants:

Brno University of Technology (VUT) – Assoc. Prof. Ing. Marie Sedlaříková, Ing. Miroslav Zatloukal

TU Wien – Prof. Petr Gärtner, Christian Hametner, Prof. Günter Fafilek

Date: February 14, 2023

The purpose of the meeting was the handover of prepared mixtures of metal powders with a binder for thermal processing at TU Wien. Parameters for sintering were agreed upon, including the temperature profile and the inert atmosphere. After processing, tests on the samples' corrosion behavior in special solutions will be conducted at Brno University of Technology.

In the subsequent phase of the visit, possibilities for publishing an article in a special issue of the journal were discussed with the editor-in-chief of Monatshefte, Prof. Gärtner, and the Managing Editor, Ch. Hametner.

2. Purpose and Venue of the Trip: TU Wien – technical meetings within the AKTION project

Participants:

Assoc. Prof. Ing. Marie Sedlaříková, CSc., Ing. Miroslav Zatloukal, Ing. Jan Kuchařík

Meeting Partner:

Prof. Günter Fafilek

Date: October 19-20, 2023

The purpose of the meeting was to assess the results of collaborative research within the AKTION project. The outcomes of the preparation and testing of biocompatible sintered materials based on metal powders were evaluated. The final form of the joint scientific publication, to be released in the journal Monatshefte für Chemie - Chemical Monthly, was reviewed. Agreement was reached on preparing new mixtures for sintering, and the testing methodology was approved.



Additionally, dates for visits of TU Wien staff to Brno University of Technology (VUT) and vice versa in the coming months until the end of the year were clarified. New material mixtures will be prepared and subsequently handed over for sintering in an inert atmosphere at TU Wien during the next meeting there. The project plan for AKTION in 2024 was discussed, with the submission deadline set for March 15, 2024, and the implementation period from July 1, 2024, to October 31, 2024.

3. Purpose and Venue of the Trip: TU Wien – technical meetings within the AKTION project

Participants:

Assoc. Prof. Ing. Marie Sedlářková, CSc., Ing. Miroslav Zatloukal

Meeting Partners:

Prof. Günter Fafilek, Lars Varain

Date: November 6-7, 2023

The purpose of the meeting was to assess the recent results of sintered samples fired at TU Wien from prepared mixtures of metal precursors with a new composition. The samples are gradually being tested at Brno University of Technology (VUT), and partial results have been used in a collaborative scientific article scheduled for publication by the end of the year. Adjustments will be made to the sintering temperatures during their thermal processing, and a preforming step involving pressing in special forms will be employed.

Additionally, individual time delays at defined temperatures will be modified. Topics for continued collaboration in 2024 were discussed during the meeting, with a plan to submit a proposal by March 15, 2024, and an anticipated start date of July 1, 2024.

Student stays at TU Wien:

Participant: Ing. Jan Kuchařík

Date: October 19-28, 2023

During the study stay at TU Wien, properties of sintered metal materials with different compositions were investigated, particularly focusing on modified sintering methods. The influence of binder content and the temperature-time profiles of sintering were studied. The impact of the sintering atmosphere was also monitored. Materials prepared at VUT Brno were utilized, and after processing, corrosion properties were measured in Brno. The results will serve as a basis for the continuation of collaborative research.

Participant: Bc. Petra Slotová

Date: November 6-15, 2023

During the study stay at TU Wien, the master's student familiarized herself with the possibilities of utilizing the equipment in Vienna's laboratories. Samples of sintered materials were prepared during the stay, partially tested on equipment at TU Wien, and additional tests were conducted in Brno. These included measurements of conductivity and pH in physiological test solutions, depending on the exposure time to prepared samples at temperatures close to 37°C.

Visits of TU Wien Staff to Brno University of Technology

Academic Staff Work Stays:

Dates: June 26, 2023; November 6-8, 2023; December 4-5, 2023



The academic staff work stays from TU Wien primarily aimed at evaluating research results. Processed samples of sintered materials were handed over, and the reasons for some unsuccessful procedures were thoroughly analyzed. During expert consultations, modifications to the initial metal powder materials, quantities, and types of polymer binder components were agreed upon. Adjustments were made to the methods of thermal processing and the composition of the protective atmosphere during sintering.

The visits also involved evaluating discussions with the editor of the scientific journal, refining the submission dates of the article, and scheduling expert reviews by top specialists. As a result, the revised article will be submitted in October 2023. Based on the outcomes, topics for collaboration in the research of special materials for 2024 were prepared. Testing of current samples is of a long-term nature, and the AKTION project will be submitted on March 15, 2024, with a proposed start date of July 1, 2024.

Student Work Stays:

Participants: Lars Varain, Elias Vígl

Dates: June 19-20, 2023

During a short study stay, students familiarized themselves with the equipment at VUT Brno, especially with materials testing devices, such as electrochemical methods and imaging equipment (optical microscopes, ESEM microscopes with EDAX analyzer, etc.). They also learned about sample preparation possibilities for corrosion property tests.

Participant: Lars Varain

Dates: August 28 - September 5, 2023; November 17-25, 2023

The study stays focused on preparing precursors for future material samples. Subsequently, alternatives for further processing in the form of sintered biocompatible metal samples were prepared. Alternatives for thermal processing were assessed, including the temperature profile of sintering, time delays at different temperatures, and the influence of different types of atmospheres. Basic corrosion tests were then conducted using classical electrochemical methods. The processed results were used in a joint scientific publication. Some tests will be carried out at TU Wien and will be part of further collaboration between the two universities.

Evaluation of Cooperation between Universities:

1. Goals outlined in Project No. 95p2 were achieved.
2. Internships and work stays of academic staff and students at both universities were successfully conducted.
3. Results of the joint research were summarized in an article published in a renowned journal.
4. In addition to the results presented in the scientific article, further material samples were prepared, and tests will continue in 2024.
5. Proposed tests are of a long-term nature, and upon agreement of both partners, a project will be requested with a start date of July 1, 2024 (application deadline is March 15, 2024).
6. The most significant outcome is the expansion of long-term collaboration on both academic and student levels.

Attachment: List of project researchers + publications

Brno, January 23, 2023

