

# Wear resistant duplex interpenetrating ceramics and ceramic-based composites intended for dry machining of alloys and other tribological applications

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## Summary

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*The PhD position is opened for an Early State Researcher to be involved into materials science and tribological research of novel machining tool materials (inserts). These machining tools should be suitable for dry cutting of hard-to-cut materials. For their production the reduced amount of Critical Raw Materials should be used. Novel materials should reduce the waste of cutting fluids (usually used to cool down the tool, etc) and risk of health issues associated with use of such liquids. The main work will be associated with fulfillment of activities of European M-ERA.NET project.*

Research field:	Production and materials engineering, robotics, transport and logistics
Supervisors:	Prof. Dr. Irina Hussainova Dr. Maksim Antonov
Availability:	This position is available.
Offered by:	School of Engineering Department of Mechanical and Industrial Engineering
Application deadline:	Applications are accepted between June 01, 2022 00:00 and June 30, 2022 23:59 (Europe/Zurich)

## Description

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The **project aims** at utilization of beneficial properties of duplex interpenetrating ceramics and ceramic-based composites to obtain optimized sintered machining tool materials with improved wear resistance.

The **objective** is development of innovative wear-resistant materials with reduced amount of Critical Raw Materials (CRM: Co, W, etc) for machining of hard-to-cut materials. It is also intended to utilize powders of recycled material.

The **goals** of the project are: (1) To reduce price of cutting tool material while maintaining high wear resistance. (2) To use Spark Plasma Sintering (SPS) and/or Pressure-less Sintering for production of optimized materials. (3) To obtain materials with sufficiently high hardness and fracture toughness. (4) To enable dry machining of hard-to-cut materials to reduce waste and risk of health issues. (5) To develop technology for recycling of cutting inserts.

### Supervisors

Main supervisor: Dr. Maksim Antonov  
Co-supervisor: Prof. Dr. Irina Hussainova

### Responsibilities and (foreseen) tasks

- To perform research on ceramics and ceramic-based composites to be processed by powder metallurgy, SPS, SLM or other methods
- To model/design (using CAD) the topology/architectures of the samples to be tested
- To collect data and conduct case studies on the selected cases on experimental approaches and institutional innovations
- To characterize the materials (tribological, microstructure, composition, mechanical properties)
- To contribute to the organization of research and workshops where project findings are presented

### Applicants should fulfil the following requirements:

- a master's degree in Materials Sciences or Materials Engineering (preferably in tribology, metals and ceramics; materials chemistry; and powder metallurgy)



- skills and experience in tribological, materials microstructural characterization (optical microscopy, SEM, XRD etc) by use of quantitative methods
- a clear interest in the topic of the position
- excellent command of English
- strong and demonstrable writing and analytical skills
- capacity to work both as an independent researcher and as part of an international team
- capacity and willingness to provide assistance in organizational tasks relevant to the project

**The following experience is beneficial:**

- Experimental and/or theoretical chemistry
- Experience/knowledge in powder metallurgy/additive manufacturing
- Working knowledge of thermodynamic calculations
- Working knowledge of CAD
- Scanning electron microscopy, XRD, Raman spectroscopy
- Mechanical testing

**We offer:**

- 4-year PhD position in one of the largest, most internationalized and only University of Technology in Estonia with a large portfolio of ongoing pan-European and national projects
- The chance to do high-level research in an international team
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers all over the world

**About the department**

The Department of Mechanical and Industrial Engineering focuses on the engineering side of industrial process automation, developing new coatings and additive manufacturing developments. The bachelor's, master's and doctoral level programmes have hundreds of graduates each year. We also provide engineering services for industry and our partners, starting with modelling and finishing with production optimization.

TalTech houses state-of-the-art powder metallurgy and additive manufacturing laboratories, plus laser, optical, metrology and chemical labs and equipment – the ideal environment for world-class materials development.

**Additional information**

For further information, please contact Senior Researcher, PhD (Maksim.Antonov@taltech.ee) or visit <https://taltech.ee/en/department-mechanical-and-industrial-engineering>

and

<https://taltech.ee/en/tribo>



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