ANNAMÁRIA NAUGHTON DUSZOVÁ

Institute of Material Research Slovak Academy of Sciences

Project number
1152/01/01

Project duration
10/2021- 9/2025

"After the completion of the project, I would obtain an overview of a microstructure investigation of developed systems at micro and nano/ atomic level; micropillar and micro-cantilever testing of individual grains and grain boundaries of the developed UHTC's, tribological characterisation of the new UHTC's and would improve my skills. in the part of materials development.
I will also have the opportunity to co-supervise masters and PhD students and to develop links and projects with industrial collaborators. All of these new experiences and knowledge together with my existing knowledge and expertise will accelerate my development as a fully independent mature researcher, and thereafter, potentially an international research leader."

SASPRO 2

BIOGRAPHY

Dr. Annamaria Naughton Duszova, (Doctor of Materials Science and Technology and Advanced Ceramics, project leader and PhD co-promotor), has wide-ranging experience of international research on ceramics, composites and ceramic matrix nanocomposites for applications under extreme conditions. In 2016, Dr. Naughton Duszova became the leader of an international project - Reintegration, which focused on the development of ultra-high temperature ceramic materials (UHTC), such as: ZrB2, TaC and HfC. As a SASPRO 2 project leader, she is working on the development of high-entropic UHTCs using Spark Plasma Sintering and subsequent detailed microstructural analysis. She has won several scientific awards, as well as grants and scholarships at many top international institutions. She has extensive experience in project management (PRINCE2 Cert), as evidenced by two patent applications. She is the author/co-author of 32 peer-reviewed publications and book chapters in the field of advanced ceramics with 948/831 citations in SCOPUS and an h-index of 14.

"Participation in this research project, particularly within IMR-SAS as a host institute, will profoundly affect my career of beyond current possibilities. This research project will significantly broaden my knowledge and experience, giving me new skills and competencies that will accelerate my future scientific career and development. These new/enhanced skills include lecturing & leadership, access to more suitable laboratory conditions and greater collaboration options within the application sector."

PROJECT SUMMARY

Dual-phase high-entropy ultra-high temperature ceramics

The main objective of the proposed project is the development, processing and characterization of new dual-phase high-entropy ultra-high temperature ceramics (DPHE-UHTC's) with expected significantly improved room and high/ultra-high temperature properties. The systems will be prepared using high quality commercial carbides and borides as the starting powders along with graphite additive, high energy ball milled in argon, to form two high-entropy phases via spark plasma sintering (SPS). The microstructure characteristics of the investigated systems will be studied at micro, nano and atomic level using x-ray diffraction (XRD), a scanning electron microscope (SEM) and transmission electron microscopy (TEM, HREM) connected with EDS analysis. The mechanical properties – hardness, bending strength and fracture toughness will be performed using standard tests. Fracture characteristics as fracture origins and fracture mechanisms will be investigated with fractographical methods.

Micro/nano mechanical tests - nanoindentation, micropillar and microcantilever tests will be used for the characterisation of the properties of individual grains and grain boundaries. Tribological properties will be investigated at room and high temperatures up to 800 °C and the wear characteristics will be studied using advanced methods under focused ion beam (FIB), SEM, TEM and Raman spectroscopy. The high–temperature characteristics of the systems will be studied under oxidation, ablation, thermal shock resistance and creep deformation using advanced methods. The relationship "processing – microstructure – properties" for the developed systems will be determined.

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PUBLICATIONS

1. **Duszová, A.**, Dusza, J., Tomášek, K., Blugan, G., Kuebler, J.: Microstructure and properties of carbon nanotube/zirconia composite, (2008) Journal of the European Ceramic Society, vol.28, p.1023-1027. https://doi.org/10.1016/j.jeurceramsoc.2007.09.011

2. **Duszová, A.,** Hvizdoš, P., Lofaj, F., Major, Ł., Dusza, J., Morgiel, J.: Indentation fatigue of WC-Co cemented carbides, (2013) International Journal of Refractory Metals and Hard Materials, vol.41, p.229-235. https://doi.org/10.1016/j.ijrmhm.2013.04.006

3. **Duszová, A.,** Halgaš, R., Bl'anda, M., Hvizdoš, P., Lofaj, F., Dusza, J., Morgiel, J.: Nanoindentation of WC-Co hardmetals, (2013) Journal of the European Ceramic Society, vol.33, p.2227-2232. https://doi.org/10.1016/j.jeurceramsoc.2012.12.018

4. **Duszová, A.,** Dusza, J., Tomášek, K., Morgiel, J., Blugan, G., Kuebler, J.: Zirconia/carbon nanofiber composite, (2008) Scripta Materialia, vol.58, p.520-523. https://doi.org/10.1016/j.scriptamat.2007.11.002

5. Kvetková, L., **Duszová, A.**, Hvizdoš, P., Dusza, J., Kun, P., Balázsi, C.: Fracture toughness and toughening mechanisms in graphene platelet reinforced Si3N4 composites, (2012) Scripta Materialia, vol. 66, p.793-796. https://doi.org/10.1016/j.scriptamat.2012.02.009

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 945478.