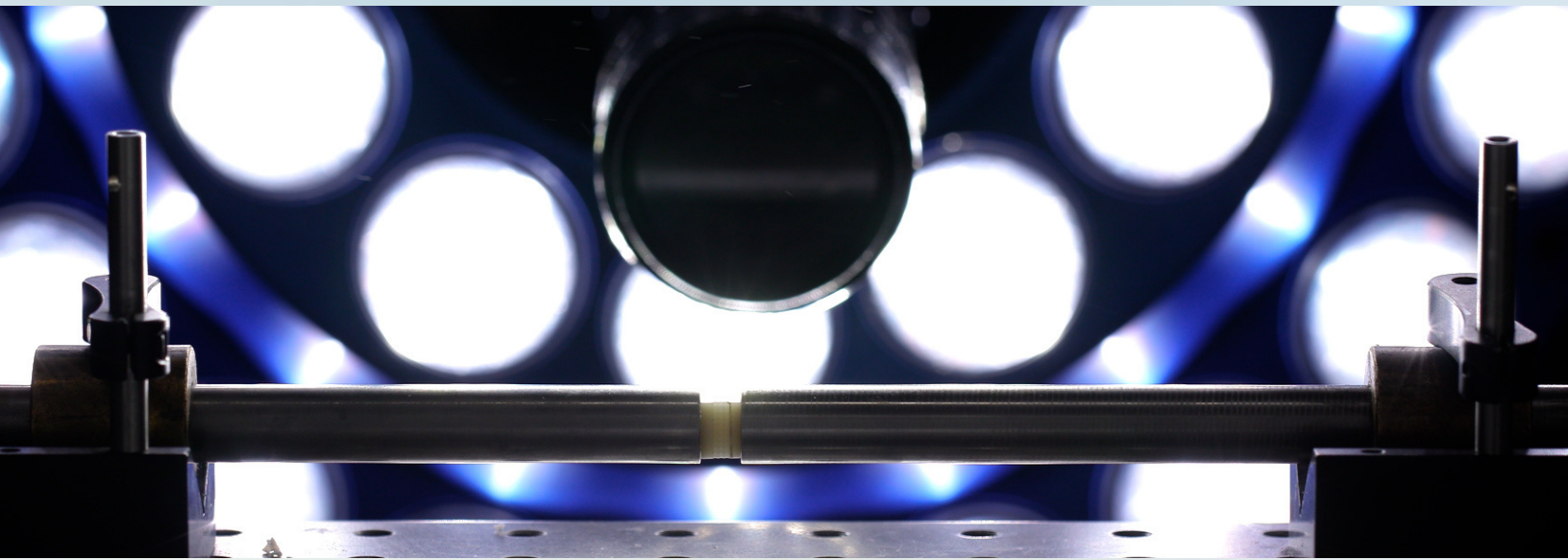


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Canadian Research on Materials under Extreme Environments

Newsletter for the NSERC Alliance Grant (No. ALLRP 560447 – 20)



Meet the Alliance Academic Team!

Principal Investigator: Dr. James Hogan - University of Alberta

Academic Leads:



Dr. James Hogan - UAlberta (jdhogan@ualberta.ca)

- Dr. Hogan is an expert in the dynamic behaviour of materials, including advanced ceramics, metals, ceramic and metallic-based composites, and high-entropy alloys. His research program involves materials science, experimental mechanics, and computational mechanics.



Dr. Mauricio Ponga - UBC (mponga@mech.ubc.ca)

- Dr. Ponga is an expert in multi-scale modelling of materials (i.e., large-scale ab-initio simulations, molecular dynamics, and continuum models), including studying high-strain rate events, heat and mass transport at the nanoscale, and long-term behaviour of materials.



Dr. Solomon Boakye-Yiadom - York (sboakyey@yorku.ca)

- Dr. Yiadom is an expert in advanced manufacturing and characterization of the dynamic/shock-loading deformation and damage response of materials.

Academic Team Members:

- Alexandra Komrakova - UAlberta
- Dan Romanyk - UAlberta
- Chong-Qing Ru - UAlberta
- Patricia Dolez - UAlberta
- Xiaoliang Jin - UBC
- Chad W. Sinclair - UBC
- Cuiying Jian - York
- Alex Czekanski - York

Program Overview:

The NSERC Alliance grant is a 5-year 3.2M+ program that involves three universities (UAlberta, UBC, York), a governmental research agency (DRDC), and two industrial partners in the defence industry (GDLS-C, vehicle OEM, NP Aerospace, armour manufacturer).

The ultimate objective of this partnership is to develop new Canadian-made ceramic-based add-on armour solutions for use on armoured vehicles to protect against standardized NATO-identified medium-level threats.

The Alliance Program involves 15 core activities and 18+ HQPs across multiple material systems (ceramic, steel, composite). The Program pushes the state-of-the-art materials characterization and testing, computational material science and modelling, and armour manufacturing and testing. Training, workshop, and internship opportunities are core in the Program.

We acknowledge the support of the Natural Sciences and Engineering Research Council of Canada (NSERC).

Nous remercions le Conseil de recherches en sciences naturelles et en génie du Canada (CRSNG) de son soutien.

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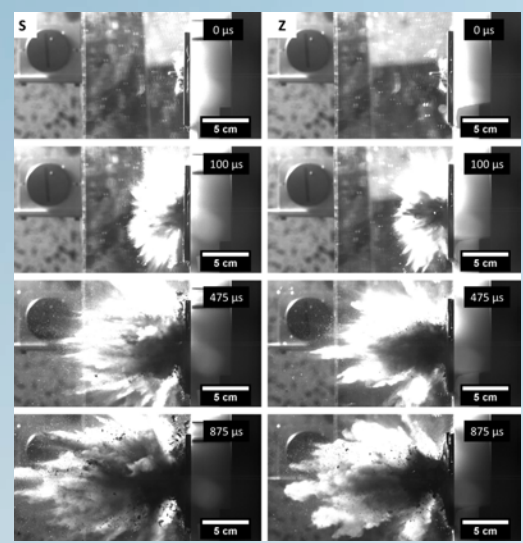
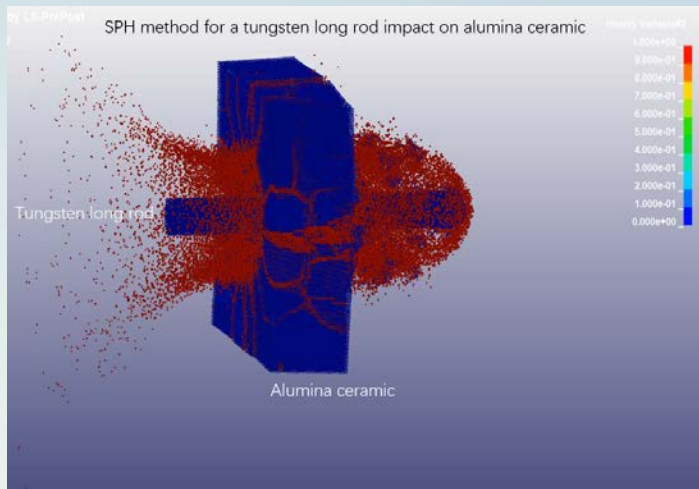
Instagram: @nserc_crsg

HQP Research Highlights

Alex Yang (MSc student) is working on structural-scale modelling of ceramics under high-velocity impact by incorporating the user-defined Johnson-Holmquist-Beissel (JHB) material model within the framework of Smoothed Particle Hydrodynamics (SPH) in LS-DYNA software. His later works will involve modifying the functional form of the existing JHB model.

The objective of his research is to evaluate the failure mechanisms that govern the dynamic response of ceramics subject to complex loading (e.g., dynamic impact loads) and investigate different structural design aspects for improving the performance of the ceramics using numerical modelling.

The figure below shows the fracture and fragmentation behaviour of an alumina plate under long rod impact.



An article titled "On the Evaluation of Mechanical Properties and Ballistic Performance of Two Variants of Boron Carbide" by Calvin Lo (MSc student) and Haoyang Li (Alliance Project Manager) was published in the International Journal of Impact Engineering (<https://doi.org/10.1016/j.ijimpeng.2021.103846>).

This work was funded by Defence Research and Development Canada (DRDC) and Milburn Mountain Defense Ltd.

This study compares the microstructure, rate-dependent compressive behaviour, and ballistic performance of commercially available boron carbide and boron carbide composite. Insights are provided on linking the mechanical and ballistic performance with microstructural features and the failure mechanisms.



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Coming Up...

The Canadian Society for Mechanical Engineering International Congress (CSME 2022) will be held at the University of Alberta on June 05 - 09, 2022.

- The Alliance team is planning to host a symposium and workshop during the conference (more details to come)
- Potential topics include statistics, machine learning, computational material science, and experimental mechanics.

Inquire with Dr. Hogan about interest.

Contact

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