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MULTISCALE MODELLING AND CHARACTERISATION IN STRUCTURAL MATERIALS

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ABSTRACT

This invited session focuses on multi-scale studies utilising advanced computational modelling and characterisation techniques to elucidate the deformation and strengthening mechanisms of structural materials. Various computational frameworks, including emerging data-driven methodologies [1], have been developed to bridge multiple length scales, spanning the quantum and atomistic levels to the macroscopic scale, in an effort to better predict material response and structural behaviour.

These approaches are fundamental to improving our understanding of the underlying physics of materials and are essential for accelerating the design of next-generation materials with optimised properties. In this context, advanced characterisation, particularly in-situ and data-intensive time-resolved studies [2], is increasingly vital for validating these computational frameworks and discovering novel mechanisms.

This session aims to showcase recent research employing computational, experimental, and hybrid approaches to study structural materials, especially under complex loading conditions where the material microstructure evolves during deformation.

Topics of interest include:

- Scale-bridging and multiscale computational frameworks
- Advanced modelling and characterisation of microscale material behaviour
- Integration of theoretical, experimental, and data-driven methodologies
- Practical applications of the integrated approaches

REFERENCES

[1] Kambayashi, K., Watanabe, I., Computational microstructure design for mechanical property optimization: a Review, *Sci. Tech. Adv. Mater.: Methods*, Vol. 5, 2581359, 2025.

[2] Briffod, F., et al., Understanding strain localization in metallic materials: a review of high-resolution digital image correlation and related techniques, *Sci. Tech. Adv. Mater.*, Vol.27, 2630488, 2026.