InMa 2024

Tuesday 19 November 2024 - Wednesday 20 November 2024

TZA am Europaplatz

Topical sessions

Structural and energy materials

In both structural and energy materials, the interfaces are where significant interactions occur that determine the overall behavior and efficiency of the material. The control and engineering of these interfaces are therefore crucial to optimizing the performance of these materials in their respective applications. In this session, we will explore the critical role of interfaces in determining the properties and performance of such materials. We will discuss how e.g. grain boundaries and phase boundaries influence mechanical behavior in structural materials, while also examining the impact of e.g. electrode-electrolyte interfaces, heterojunctions, and catalyst-support interactions in energy materials. Through advanced characterization techniques, we aim to deepen our understanding of these interfaces and their role in optimizing material performance across various applications. This includes how such materials are being used in a sustainability context and how interfaces of such materials play a role in recycling or such.

Materials in harsh environments

Interface-dominated materials are particularly sensitive to harsh environments because the interfaces within these materials are often the first to experience degradation or failure under extreme conditions. This session will focus on the impact of harsh environments on the properties and durability of interface-dominated materials. We will explore how interfaces respond to extreme conditions including temperature extremes, corrosive environments, mechanical stress, hydrogen exposure, radiation, and oxidation. Emphasizing the susceptibility of these interfaces to degradation, the session will highlight advanced characterization techniques and strategies for enhancing material performance and reliability in demanding applications.

Interfaces of architecture materials

Architectured materials are considered interface-dominated because their unique properties and performance arise from the engineered interfaces within their structure. These materials are designed with specific architectures, such as layered, cellular, or composite structures, where the interfaces between different components, phases, or structural elements play a critical role in defining and tailoring their behavior that meet mechanical, thermal, electrical, or adaptive needs, making them highly versatile for a wide range of advanced applications. This session will delve into the critical role of interfaces in architectured materials, where engineered internal structures such as layered, cellular, or composite architectures give rise to unique and tunable properties. We will explore how interfaces govern mechanical behavior, energy absorption, damage tolerance, and multifunctionality in these materials. Through advanced characterization techniques, the session will highlight how the strategic design and control of interfaces enable architectured materials to achieve optimized performance across various scales and applications, making them a cornerstone of modern material innovation.

In situ/operando characterization

In situ and operando experiments are invaluable for characterizing interface-dominated materials because they provide real-time mechanistic insights into how interfaces behave under conditions that closely replicate actual service environments revealing the critical role of interfaces in determining material performance e.g. in harsh environments, during mechanical stress, and throughout energy cycles. By employing advanced microscopy, spectroscopy, and mechanical testing techniques, these experiments allow researchers to understand and optimize the

performance of materials where interfaces play a crucial role, leading to the development of more reliable and high-performance materials for structural and energy applications.

Computational science of interfaces

Computational science plays a pivotal role in the study of interfaces in interface-dominated materials, offering deep insights into their characterization and properties. By simulating and modeling the behavior of interfaces at various scales, computational approaches help researchers understand the fundamental mechanisms that govern material performance, guide experimental efforts, and predict the behavior of materials under different conditions. This session will explore the critical role of computational science in understanding and optimizing interfaces within interface-dominated materials. We will discuss how advanced modeling techniques, from atomic-scale simulations to multiscale approaches, provide deep insights into interfacial behavior, stability, and property prediction. By integrating computational methods with experimental data, this session will highlight how simulations guide material design, interpret complex characterization results, and accelerate the development of materials with tailored interfacial properties for enhanced performance across diverse applications.

Advances in methodology and informatics

This session will highlight the transformative impact of advances in methodology and informatics on the characterization and properties of interface-dominated materials. We will explore the role of machine learning in analyzing complex datasets, predicting material properties, and optimizing interfacial characteristics, facilitating rapid material discovery and design. Additionally, we will discuss novel experimental methodologies, such as high-throughput characterization, advanced imaging techniques, and in situ monitoring, that provide real-time insights into interfacial behavior under operational conditions. By integrating these approaches, this session aims to demonstrate how innovative techniques and data-driven strategies are advancing our understanding of materials at their interfaces, leading to enhanced performance across diverse applications.