Consiglio Nazionale delle Ricerche

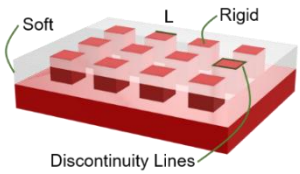
Istituto di Chimica e della Materia Condensata e di Tecnologie per l'Energia

ICMATE

This webinar of "MATERIALS MATTER!" deals with the fundamental topics of the PRIN project "SMARTICE: Advanced de-icing surfaces based on engineered shape memory alloys".

Understanding and controlling icing: an interdisciplinary challenge

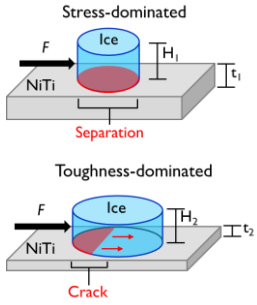
Icing – the process of ice formation on surfaces - is a complex phenomenon with several open questions. The EU project SURFICE "Smart surface design for efficient ice protection and control" has combined experimental, theoretical, and engineering approaches to address the three following objectives: (i) investigation of the physics of icing of morphologically complex microstructured surfaces, (ii) rational design of new icephobic/anti-icing materials and coatings, (iii) development of new technologies and systems for efficient ice prevention and control. During the talk, Carlo Antonini will provide an overview of the project results, discussing in particular the concept of discontinuity-enhanced icephobicity. Project web site: www.surfice-itn.eu



Prof. Carlo Antonini *is associate professor in the Department of Materials Science at the University of Milano-Bicocca. He leads the SEFI Lab (Surface Engineering and Fluid Interfaces Laboratory), where the main research pillars are wetting (including icephobicity), polysaccharide-based materials and 3D printing.*

Evaluating Ice Adhesion and Exploring Icephobic Properties of Nickel-Titanium

Ice accumulation on industrial structures poses risks to equipment and safety. Low ice adhesion coatings and active de-icing systems are used to mitigate these risks. Accurate ice adhesion measurement is vital for evaluating new icephobic materials, but current methods like average shear stress often yield inconsistent results by neglecting stress concentrations and fracture mechanisms. This study analyzes the horizontal shear test and develops a framework considering both stress- and toughness-dominated fractures, providing a comprehensive protocol for assessing icephobic surfaces. Applying this framework to Nickel-Titanium (NiTi) reveals its icephobic properties and passive de-icing capabilities.



Dr. Luca Stendardo*, research fellow at CNR-ICMATE (Lecco), M.Sc. in Mechanical Engineering and PhD in Materials Science and Nanotechnologies. His main research interests are related to the study of surface wettability, icephobicity, and interfacial fracture phenomena.*

A leaner thermal model for the transient 3D simulations of Shape Memory Alloys

Shape Memory Alloys (SMAs) are advanced materials of growing interest due to their ability to undergo solid-phase transitions under mechanical and thermal stimuli, altering their crystalline structure. These properties make them ideal for actuation systems. While SMA-based systems already exist, accurately predicting their thermomechanical behavior remains a challenge. Phenomenological models are commonly used, often emphasizing mechanical aspects while simplifying thermal effects. Fully coupled models, though more accurate, are computationally demanding. This study addresses the gap in thermal simulation by proposing a simplified, case-independent model that reformulates Liang & Rogers' martensitic functions, accounting for partial transformations and enthalpy changes, and compatible with thermo-mechanical coupling.

Jacopo Mazzini, *first-year PhD student in Energy Engineering at the University of Pisa. His research focuses on the thermomechanical modeling of advanced materials using multiphysics simulations. Currently, he theoretically investigates phase change phenomena that govern the behavior of shape memory alloys.*

In collaboration with:

Università degli Studi di Milano Bicocca

SEFI Lab

Università di Pisa

Webinar "MATERIALS MATTER!"
Prof. Carlo Antonini, University of Milan-Bicocca
Dr. Luca Stendardo, CNR-ICMATE Lecco
Jacopo Mazzini, University of Pisa

18 June 2025 h 15:00 – 16:30

Participation LINK

This project has received funding from the Italian Ministry of University and Research under the PRIN 2022 call through the project "SMARTICE Advanced de-icing surfaces based on engineered shape memory alloys".

Finanziato dall'Unione europea NextGenerationEU

Ministero dell'Università e della Ricerca

Italiadomani Piano Nazionale di Ripresa e Resilienza