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SurPhase – Sustainable Surface Engineering with AI, Multiscale Modeling, and Additive Manufacturing for Enhanced Phase-Change Heat Transfer

The SurPhase project is dedicated to training the next generation of experts in sustainable surface engineering, artificial intelligence, numerical modeling, and additive manufacturing for phase-change heat transfer applications. 12 Doctoral Candidates will receive world-class training combining advanced research, industrial experience, and transferable skills through a multidisciplinary international consortium. This program will prepare DCs to tackle global energy challenges, equipping them with expertise in cutting edge technologies and fostering their career development in academia and industry. The project focuses on revolutionizing phase-change processes, boiling, and condensation, which are fundamental to energy, water, and cooling systems. Traditional approaches are often limited by inefficient surface designs and environmentally harmful coolants. SurPhase addresses these challenges by integrating advanced surface engineering, AI-driven optimization, multiscale numerical modeling, and AM to enhance thermal performance, sustainability, and scalability. Tailored surfaces will be fabricated using microfabrication and AM techniques, optimizing the phase-change process by improving nucleation, secondary phase mobility, and two-phase flow dynamics. AI-driven tools will accelerate surface design by utilizing data from experiments and simulations, while Molecular Dynamics and Computational Fluid Dynamics will provide insights into interfacial transport phenomena. Sustainability is a core principle of SurPhase, focusing on low-global warming potential coolants, energy-efficient fabrication methods, and waste reduction. Collaborative efforts with industry partners will ensure real-world applicability, while the DCs' interdisciplinary training will drive innovation and ensure impactful outcomes. SurPhase aims to set new standards in thermal management, energy efficiency, and environmental sustainability by delivering breakthrough technologies and a skilled workforce.

Coordinator: The University of Birmingham

Beneficiary: Università di Padova

UNIPD Supervisor: Simone Mancin

Department: Department of Industrial Engineering

Total Contribution: € 3 631 958,64

Project Duration in months: 48



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Find out more: [SurPhase](#)