NIMP / INCDFM Partner Profile — CM2026-09

Integrated Industrial Energy Systems | Role: Beneficiary Partner
THERM-ADAPT — Thermally Adapted Bulk Interfaces for High-Temperature Industrial Energy Systems

Project concept

High-temperature industrial energy systems, including electrified thermal-processing equipment, hybrid kilns, and waste-heat-recovery components, are increasingly exposed to repeated thermal transients, steep temperature gradients, and thermomechanical constraints. In such components, service life is frequently limited by interface-related degradation between dissimilar materials, including cracking, delamination, loss of contact, and a progressive increase in thermal resistance.

THERM-ADAPT develops application-adapted bulk metal–ceramic interface architectures to control heat transfer and mitigate thermal expansion mismatch in high-temperature industrial components. The concept is positioned under **CM2026-09: Integrated Industrial Energy Systems**, with primary relevance to **Pathway 1B** and secondary relevance to **Pathway 2B**.

What NIMP offers

NIMP contributes a self-contained research and technology work package covering the design, manufacturing, and validation of thermally adapted bulk interfaces. The contribution includes:

- requirement-driven design of graded interface architectures;
- CALPHAD-based phase-stability and compatibility screening;
- FEM/COMSOL thermal and thermomechanical modeling;
- powder-based manufacturing of macroscopic graded layers, interlayers, and inserts;
- near-net-shape and segmented manufacturing of bulk interface elements adapted to component geometry;
- high-temperature thermophysical characterization by LFA, dilatometry, and calorimetry;
- constrained hierarchical assessment of interface thermal behavior using reference materials, bilayers, and complete assemblies;
- microstructural analysis, fracture evaluation, and high-temperature mechanical testing;

- component-relevant laboratory validation before transfer to industrial demonstration.

Near-net-shape capability is relevant for industrial transfer because it allows interface elements to be produced closer to the final component geometry, including modular, sectorial, polygonal, or insert-based architectures. This reduces machining, material losses, and post-processing requirements, while enabling the geometry to be treated as a design variable alongside composition, thermal conductivity, and thermal expansion.

The contribution builds on published NIMP experience in graded bulk materials, metal–ceramic thermal barriers, high-temperature thermophysical characterization, and component-oriented interface design. The proposed project does not prescribe a fixed material composition; the operating envelope and compatibility requirements of the industrial use case will drive material selection.

Available infrastructure

NIMP has in-house infrastructure for the full laboratory workflow:

- SPS/FAST and hot-press facilities for bulk consolidation, interface manufacturing, and near-net-shape processing;
- LFA for thermal diffusivity and multilayer thermal analysis up to 1100°C;
- dilatometry for dimensional-change and CTE assessment up to 1600°C;
- DSC/TG/DTA/SETSYS facilities for Cp determination, phase-transition analysis, and thermal-reaction screening;
- FE-SEM with BSE/EDX/EBSD, HRTEM, XRD, and WDXRF for structural and compositional analysis;
- Instron 5982 mechanical testing system with 100 kN load cell and high-temperature ATS controlled-atmosphere furnace for 3PB, compression, and cyclic testing under suitable specimen configurations;
- CALPHAD, FEM/COMSOL, and SolidWorks capability for design and interpretation.

Partners sought

Industrial end-user
A company operating high-temperature energy infrastructure in sectors such as cement, glass, steel, thermal processing, or waste-heat recovery. The industrial partner would co-define operating conditions, component geometry, validation requirements, and access to a relevant test environment.

Coordinator / RTO / system integrator
A partner already building or willing to coordinate a CM2026-09 consortium, preferably with experience in CETPartnership or Horizon Europe projects and with links to an industrial demonstrator.

Scale-up and validation partners
Partners can support component-scale manufacturing, system integration, techno-economic assessment, industrial validation, and exploitation planning.

NIMP is not acting as coordinator at this stage. We offer a mature technical contribution and are seeking a coordinator, an industrial end user, and partners for integration, scale-up, and component-level validation.