



From Spatially Controlled
Alloying to Industrially Qualified
Graded Transition Components





 **smart**
advanced manufacturing

The background image shows a blurred industrial scene, likely a manufacturing plant, with various mechanical parts and machinery. A green-to-purple gradient is applied over the image, creating a modern, tech-oriented aesthetic. The logo consists of a stylized green sigma symbol followed by the word 'smart' in a bold, white, sans-serif font, with 'advanced manufacturing' in a smaller, white, sans-serif font below it.

ORGANISATION PROFILE

Ion Industrial Metallurgy R&D Inc.

CORPORATE PROFILE

2019

Founded at METU Technopolis

OUR TEAM

6 people

PhD & MSc in metallurgical, materials, electronics, software chemical and welding (IIW & EWE) engineering.

R&D EXPERIENCE

SAAM Technique, KNIGHT Process Intelligence, SMART EUREKA DISTOPIA

CORE CAPABILITIES



Material Intelligence

Nadcap & ISO/IEC 17025 accredited testing, characterisation and structural integrity.



Advanced Manufacturing

Welding, DED, alloy engineering and prototype manufacturing.



Process Intelligence

Sensor integration, process monitoring and adaptive control.



PROPOSAL INTRODUCTION (I)

Graded Resilient Additive Deposition for Industrially Engineered Novel Transitions



VISION



Spatially controlled alloying → Industrial graded transition components

To industrialise functionally graded transition components through spatially controlled alloying, enabling reliable dissimilar-metal joints for demanding service conditions.

MOTIVATION



Overcoming abrupt metallurgical and mechanical property transitions in dissimilar-metal joints.

Abrupt changes in chemical composition, thermal expansion and creep behaviour, together with carbon migration, can limit the long-term performance of conventional ferritic-to-austenitic joints.

GRADIENT aims to bridge the gap between laboratory-scale graded deposition and reproducible, manufacturable, qualification-ready industrial components.

CONTENT

Modular hybrid manufacturing

Develop a modular, dual-robot SAAM platform integrating GMAW, laser processing and secondary-wire feeding for controlled alloy deposition.



Metallurgical gradient design

Design and optimise composition gradients, melt-pool mixing and microstructural homogeneity through modelling and experimental validation.



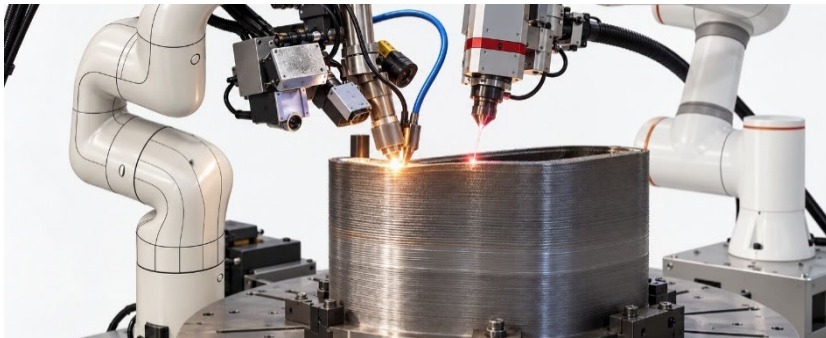
Process intelligence & traceability

Employ KNIGHT for sensor-guided manufacturing and S'GMA for layer-resolved process traceability and a digital material passport.



Component-level validation

Manufacture and characterise graded transition demonstrators, including high-temperature mechanical and creep testing, and establish a pathway towards industrial qualification.



PROPOSAL INTRODUCTION (II)

Graded Resilient Additive Deposition for Industrially Engineered Novel Transitions



EXPECTED OUTCOMES

Modular SAAM manufacturing cell

A modular dual-robot laser-GMAW additive manufacturing cell with secondary-wire feeding for spatially controlled alloying.

Validated spatial alloying methodology

Reproducible composition gradients, controlled melt-pool mixing and improved metallurgical homogeneity.

P91-NiCrMo-SS316L fitting demonstrator

A graded transition component demonstrator supported by microstructural characterization and structural integrity assessment including creep-performance data.

Digital material passport

Layer-resolved manufacturing records integrating KNIGHT process data and S'GMA engineering intelligence, establishing the foundation for a component digital twin.



EXPECTED MARKET IMPACTS

Engineered, high-reliability dissimilar-metal transitions

Enabling engineered transitions between dissimilar alloys for demanding high-temperature energy and process-industry applications.

Exportable manufacturing equipment and services

Creating opportunities for modular SAAM equipment, specialised manufacturing services and distributed production.

New markets for graded components and remanufacturing

Establishing a technology platform adaptable to graded repair, remanufacturing and property-tailored metallic components.



SCHEDULE

30 - 36

months

YEAR 1

Cell development & process feasibility

YEAR 2

Gradient control & metallurgical validation

YEAR 3

Demonstrator, testing & industrial transfer

PARTNERS



CURRENT CONSORTIUM



Ion Industrial Metallurgy R&D Inc. | Process Monitoring & Adaptive Control
Materials engineering, SAAM process development, advanced manufacturing, accredited mechanical testing and structural integrity assessment.



Retina Data Technology Inc. | Data & Engineering Intelligence
Industrial-scale data management, digital material passports and S'GMA integration, with potential LLM-based engineering applications.

PARTNER SEARCH

Industrial End-User | Priority

Manufacturer or operator of high-temperature piping, fittings or pressure equipment. To define industrial requirements, provide a representative demonstrator and support manufacturability assessment and qualification.

Robotics Technology Partner

European industrial partner with expertise in dual-robot synchronisation, hybrid manufacturing-cell integration, industrial automation, and preferentially laser processing.

Alloy Design, Modelling & Characterization

Research partner specialising in phase transformations, computational alloy design, melt-pool metallurgy and advanced microstructural characterisation.

Electromagnetic Process Technology | Optional

Technology partner for investigating electromagnetic melt-pool support in graded additive manufacturing.

CONTACT INFO

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