Final Report

Project acronym: *INSURFCAST*

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M-ERA.NET Call 20*16*

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2. Publishable project summary

The overall objective of the Project INSURFCAST was to investigate and model the interfacial phenomena that occur at the metal-ceramic interphases in superalloys casting processes in order to: 1) design new compositions and characteristics for ceramic moulds and coatings, and 2) guide a proper selection of the ceramic composition and surface characteristics in relation to the characteristics of the alloy to be casted.

To this end, the following methodologies have been adopted during the Project:

- High temperature wetting experiments by the sessile drop method conducted on reference pure and industrial ceramic materials to provide the fundamental understanding of the capillarity phenomena and of the liquid distribution along the ceramic surface.
- Advanced techniques for the microstructural examinations of metal/ceramic interfaces to give information on the interfacial phenomena occurring during high temperature liquid/solid contact.
- Measurement of thermophysical properties of alloys to study the behavior of alloys in liquid and solid state as a function of temperature.
- Thermodynamic analysis by CALPHAD to give insights on the formation of deleterious phases and on the ways to avoid them.

The implementation of these methods led to the following intermediate results useful to interpret and predict interfacial phenomena occurring during casting processes:

- New data (contact angles, microchemistry, microstructures, thermophysical properties) not available in literature regarding the materials and the liquid/solid interfaces involved in casting processes.
- Thermodynamic databases (phase diagrams, energy quantities)
- New formulations of mould materials and interface coatings for casting of superalloys.

These new ceramic surfaces and compositions were validated in a relevant environment by performing technological trials consisting in casting model and selected commercial nickel superalloys. In particular, prototype examples of turbine blades made of a Ni-based superalloy (Inconel 718) using moulds ($ZrSiO_4$-based) and new coatings developed during the project were produced. As a final result, a list of proper technological recommendations in terms of materials selection for the investment casting of Ni-based superalloys was prepared.