Innovation
Fluid and Materials Research

INTERMETALLIC ALLOYS

The ESA/EC Intermetallic Materials Processing in Relation to Earth and Space Solidification (IMPRESS) project was recently selected by the European Commission (EC) as a "flagship" project in materials science and applications. The scientific objective of the project is to develop new knowledge about solidification processing, materials structures and novel, high performance intermetallic alloys - crystalline compounds composed of two or more metallic elements.

Titanium aluminides, for example, have mechanical and physical properties that make them ideal for casting of high quality turbine blades. They are used in the last stage of gas turbines, which are used in all modern power stations and aero engines. The low density, high melting point and burn resistance of the titanium aluminides results in a 50% weight reduction of components, reduced fuel consumption (hence lower exhaust emissions) and higher operating temperature (equivalent to much higher efficiency).

"Intermetallic alloys are equally important in the field of advanced catalytic powders. Catalysts work by speeding up chemical reactions and have many industrial uses, e.g. in the pharmaceutical and food industries. In the IMPRESS project, scientists will investigate catalytic powders made from nickel and cobalt aluminides. Fine, rapidly solidified particles less than 20 microns across will be produced, and then, after some further processing, used by industry to speed up hydrogenation reactions, which are vital for the production of nylon and margarine."

"ALL THE RESEARCHERS INVOLVED IN THE IMPRESS PROJECT ARE VERY KEEN TO SEE THE SCIENTIFIC RESULTS TRANSFERRED INTO HIGH QUALITY TANGIBLE PRODUCTS. ONCE SUCCESSFULLY DEVELOPED, THE IMPACT OF THESE NEW GAS TURBINE BLADES AND CATALYTIC DEVICES WILL BE TREMENDOUS - NOT ONLY ECONOMICALLY, BUT ALSO ENVIRONMENTALLY."

IMPRESS Project Team, comprising 200 world-class scientists, industrialists, post-doctoral researchers and PhD students from 15 European countries and Russia.
Companies developing and using hydrogen fuel cells will also benefit greatly from this research, since catalytic powders based on nickel and cobalt are effective, relatively inexpensive materials suitable for use as electrodes in these cells. Considerable improvements are expected in the performance, cost-effectiveness and sales potential of these pollution-free power generation systems.

The International Space Station (ISS) and other microgravity platforms will be used extensively to perform benchmark experiments on these alloys that will yield important data for validating theories and computer models. The various ISS facilities to be operated by astronauts for the IMPRESS project include:

- the Materials Science Laboratory, which permits directional solidification of intermetallic alloy samples;
- the Electromagnetic Levitator, which allows container-less melt processing and non-contact measurement of thermophysical properties;
- the IMPACT facility, which permits experiments in the field of nano-powder formation and agglomeration.

By combining the expertise of 45 materials science research groups and companies across the enlarged European Union, IMPRESS has the potential to make Europe a world leader in the development of strategically important, new technologies such as turbines and fuel cells. It will greatly strengthen the competitiveness of European industry through the successful development of high-value products with major environmental and energy-efficiency benefits. With a steadily growing demand for gas turbines and catalytic devices, market projections suggest that global sales could reach at least 45 billion by 2011.