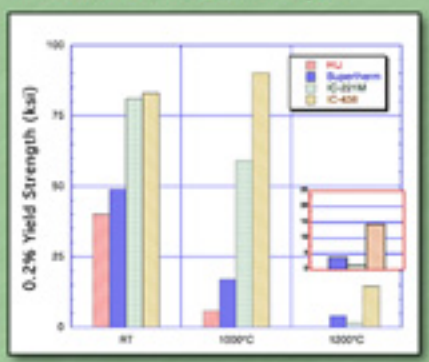
Advanced Intermetallic Alloys

The energy utilization and efficiency of industrial processes can be improved by the utilization of high temperature corrosion resistant advanced intermetallic alloys

Objective:

Provide alloy design, processing, fabrication, and materials property capabilities to develop and enable the use of advanced intermetallic alloys in high performance applications

Advanced Ni_3Al alloys



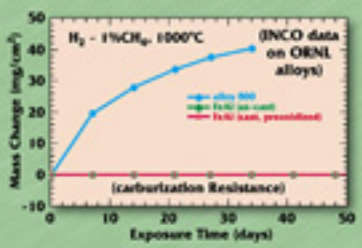
The chemical composition modification of IC438 increases the maximum use temperature of IC221M from 1100° to 1200°C

Alloy	Composition, wt%					
	Ni	Al	Cr	Mo	Zr	B
IC221M	Balance	8.0	7.7	1.43	1.5	0.008
IC438	Balance	8.1	5.2	7.0	0.13	0.005

Improved high temperature mechanical properties of Ni_3Al enables higher thermal efficiencies in industrial processes

FeAl alloys

Centrifugally cast FeAl tube



Superior carburization resistance of FeAl alloys will enable more efficient chemical processing

Ni_3Si alloys

Multi-pass welds made in cast bars confirm that some Ni_3Si alloys have excellent weldability

Ni_3Si alloys with Nb and Ti have exceptional corrosion resistance in boiling sulphuric acid

	Corrosion rate, mils/year	
Composition, at%	60% H_2SO_4	77% H_2SO_4
Ni-18.6Si	1640	35
Ni-18.9Si-3.2Nb	1158	9
Ni-18.9Si-3.2Ti	1160	3

Development of castable and weldable Ni_3Si alloys will enable fabrication of complex components for use in chemical process systems

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Advanced Intermetallic Alloys

The energy utilization and efficiency of manufacturing processes can be improved by operating at the higher temperatures or with the better environmental resistance provided by advanced intermetallic alloys.

Goal: Provide the processing, fabrication and material property expertise necessary to implement advanced intermetallic alloys in high performance applications that can benefit the most from the unique properties of these alloys.

There is a need in the manufacturing and power generation/cogeneration industries to push the safe service temperatures of metallic alloys ever higher. Increasing the operating temperature of some processes can improve their thermodynamic efficiency. In other cases, increases in operating temperature can reduce the residence time of materials at critical reaction temperatures. Each of these conditions can result in significant energy savings by promoting more efficient energy utilization, increased productivity, and reduced process down time. Likewise, there is a need to identify and utilize intermetallic alloys with improved or unique environmental resistance, which can result in similar efficiency benefits and energy savings. Currently, a Ni_3Al alloy is being developed which can withstand service temperatures of 100-150°C higher than commercial Ni_3Al alloys. Other alloys under study are based on the intermetallic alloys FeAl. Under certain conditions, these alloys have resistance to carburization and sulfidation that far exceeds that of most commercial alloys. Also being developed are alloys based on Ni_3Si. Initial testing indicates that the Ni_3Si alloys have good mechanical properties coupled with excellent resistance to oxidizing conditions, such as in sulfuric acid and sea water, and to ammonia at temperatures up to 900°C.

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