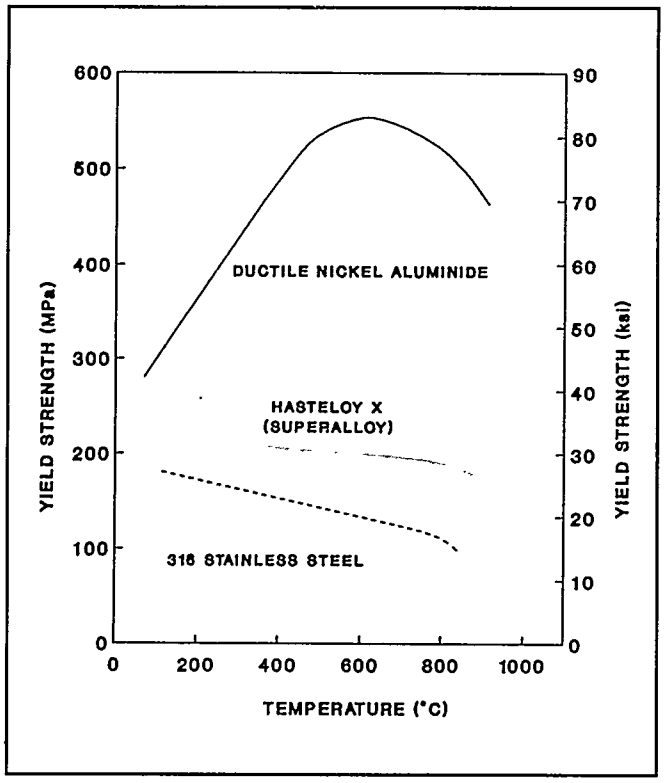
licensing agreements to date: with Cummins Engine Company, for use in large diesel engine applications; with Armco, Incorporated, one of the five largest steelmakers in the United States, for commercial mass production; with Armada Research Corporation for heating element uses for such applications as electric appliances and industrial furnaces; with Metallamics, for tool and die components; and with Valley-Todeco for aircraft fasteners.



Unlike conventional metals and alloys, nickel aluminide increases in strength at higher temperatures, making it suitable for energy-conserving, high-temperature applications.

Separation of Impurities from Molten Metals

The manufacture and fabrication of steel and other metallic materials is often complicated by the presence of nonmetallic particulates in the solidified metals. In the steel industry the movement toward thinner castings requires more stringent control of the particulate content of the metal. Earlier casting techniques that used large ingot molds and later, continuous casting required hot-rolling reductions, followed by cold rolling in order to produce sheet material. This large amount of energy-intensive mechanical working was sufficient to break up and disperse the particulates and make them relatively harmless. Newer, less energy intensive near-net-shape casting technologies do not require such substantial reductions; therefore, the particulates remain as originally formed, with possible deleterious effects to the metal's properties. To alleviate the problems associated with particulate contaminants in metals, DOE undertook the development of a magnetohydrodynamic (MHD) separator for use with liquid metals. Early work confirmed the usefulness of utilizing the molten metal as a current-carrying conductor passing through a magnetic field. This creates a body force on the metal so that it acts as if it had a higher density and causes the nonconducting particulates to flow quickly to a region where they can be skimmed or separated from the metal. Successful experiments have been performed using molten aluminum and either alumina (Al_2O_3) or silicon carbide (SiC) as the impurity particles. Two patent applications for the process have been filed, and industrial interest in the process is growing. Further technology development is being undertaken by the DOE Steel Initiative.

Genetic Engineering for Efficient Biochemical Processes

The application of genetic engineering techniques to certain microorganisms should lead to greatly reduced production costs for some organic chemicals. Microorganisms can be grown on relatively inexpensive feedstocks, such as biomass; production costs for some organic chemicals will be lower if genetically engineered processes can be scaled up. Before this potential can be realized in large-scale industrial processes, a method must be developed for stabilizing and retaining genetically engineered traits in large quantities (cultures) of microorganisms. DOE funded research developed and experimentally verified a new method of gene cloning