superior high-temperature properties can be developed through rapid cooling and gas supersaturation.

To achieve rapid solidification (at rates up to a million times faster than solidification of conventional ingots), a gas stream is used to impact and break up a stream of molten metal into fine droplets. The repetitive process produces a high concentration of atomic vacancies, which would normally anneal out of the alloy at high temperatures. The dissolved gas entrapped during rapid solidification stabilizes the vacancies in clusters, which then serve as sites for fine precipitates to form and strengthen the alloy.

Researchers have seen a 60-fold increase in the service life of austenitic stainless steels processed by this technique. Atomistic calculations were developed that accurately predict the experimentally measured solubility of inert gas in nickel. These calculations explain the evolution of the entrapped gas and produced microvoids, which may help engineers to develop new alloys and processing techniques.

This novel processing technology will have a significant effect on the advancement of more efficient energy systems through stronger, lighter alloys with longer lifetimes. The concept, which received an R&D 100 Award in 1988, also shows promise for processing iron, aluminum, nickel, and other metal-based alloys.

A Computerized Tribology Information System (ACTIS)

A significant portion of the energy used in mechanical operations is lost through friction, wear, and poor lubrication of moving parts. Tribology, the study of friction, wear, and lubrication, provides a basis for conserving energy by reducing energy losses.

Tribology research is interdisciplinary and involves lubricant chemistry, surface science and topography, interface contact, elastohydrodynamics, and mechanics. The incorporation of advances in tribology into engineering practice has been slow because of the cross-disciplinary nature of tribology research. In addition, the diversity of data often makes it difficult for engineers and scientists to locate information on advances in tribology that might help solve critical engineering problems.

DOE is trying to address this need through ACTIS. The system will facilitate validation of experimental results by tribology experts, keep researchers continually updated on new research results, serve as a clearinghouse of tribological news or research breakthroughs, and provide a central location for information on research in progress and tribological products.

The DOE Tribology Program has provided seed funding for developing ACTIS to make available to tribology researchers a broad range of data, design codes, abstracts, and bibliographies of research in progress. ACTIS is designed to allow users to access any data base through a main menu or through an interface that connects the data bases. For example, users of the design data base may require numeric data for a particular code, which they can then access in the proper format through the appropriate interface. The National Institute of Standards and Technology has taken a lead role in directing the development and management of the system. Other participants supporting the project include the U.S. Army, the U.S. Air Force, the American Society of Lubrication Engineers, the American Society of Mechanical Engineers, and several industries.

The system is now in the commercialization phase and will be available to the tribology community as IBM (or compatible) personal computer software. Revenues generated through the use of ACTIS by participating industrial sponsors and proceeds from sales of design codes will be used to support and maintain the ACTIS program.