different approaches toward the same end. The device gained immediate acceptance within the established community of basic chemistry research and became a mainstay of a continuing and highly productive line of work in high temperature and corrosive environments.

Today, the thermodynamic properties of solutions at high temperatures and pressures have many uses. Not only are they being used by geoscientists in unravelling the mysteries of mineral formations, but they have many other practical applications. They are necessary in understanding fluids used to extract energy from the earth in geothermal technologies. They are important in designing a properly protected means for permanently disposing of high-level radioactive waste. They are helping power engineers design better steam generators that are more resistant to corrosion and cracking. They are fundamental to research work in electrochemistry aimed at the development of new electrolites used in advanced batteries and fuel cells.

The successful development of the microcalorimeter was a significant advance. It has since assumed a principal role in major investigations of thermodynamic properties and has proven to be an indispensible tool for basic research. Developed modestly with no stated application, it now serves in many diverse and important ways never envisioned.

Positron Probe

A unique and potentially powerful tool for studying atoms, their orbiting electrons, and the important physical details of the surfaces of materials, recently took a significant step forward with the aid of Seed Money research.

This tool, which makes use of a rare subatomic particle known as positron, can be used to probe the atomic building blocks of nature in ways that no other tool can. Its application promises new insights into economically important areas of scientific endeavor as diverse as physical chemistry, behavior of materials, and microelectronics.

The power of this new tool stems from the unique properties of the positron. This particle is relatively lightweight and carries a positive electrical charge, enabling it to be easily manipulated by an electric field. It can be accelerated and precisely controlled at varying intensities, focused with accuracy, stored briefly, and garnered with others in sufficient numbers to be pulsed onto surfaces like a bright light beam.

Similar in many respects to its sister particle, the electron, a beam of these particles may be used to make the positron version of the more familiar electron microscope. Because the positron carries a charge opposite to that of the electron, and is thus attracted to electrons orbiting at the surfaces of atoms instead of being repelled, such a microscope would give scientists valuable new perspectives and potentially sharper resolution of certain structural details.

More significantly, however, is the fact that the positron tends to annihilate itself in the presence of an electron. In the process, it also destroys the electron and broadcasts a final, information-laden message about the precise location and circumstances of its destruction. This message also contains many scientifically important physical details about the positron's hapless electron partner.

It is this ability to search out specific parts of an atom's structure, namely the outermost orbiting electrons, or alternatively concentrations of electrons in the surface structures of materials caused by defects or the presence of impurities, and to send back physical data about these conditions that offers so much potential for scientific investigation.

Why are these particular electrons so important? Virtually all natural phenomena observable in everyday life are governed by the ways in which the specific arrangements of electrons in the outermost shells or orbits of atoms interact. The physical characteristics of these arrangements, such as the size of the shells, the number of electrons, and how tightly they are bound, establish the laws of chemistry; prescribe how individual atoms form into solids, liquids, and gases; and dictate how different elements combine into substances ranging from solid mixtures and metal alloys to liquid solutions and complex molecules.

Importantly for many high-tech industries, these electrons also impart to substances many of their unique properties, such as strength and ductility, electrical conductivity, resistance to corrosion, and in certain instances, how their molecular surfaces bond with others. Hence, a fundamental understanding of the physics of an atom's outermost electrons and the composition of materials at the atomic level lies at the heart of many crucially important technological advances.

In the highly competitive aerospace industry, for example, there is a continuing and pressing need for stronger and lighter structural materials. In recent years, this need has been met in some instances with a new class of materials, called epoxy-based, carbon-fiber composites. Positron research is now being used to investigate the molecular bonding characteristics of various types of composite fabrications. The study of damaged sections from military jet aircraft, using positron probes, has given rise to new theories as to why certain fabrications seem to be much stronger than others.

Similarly, the search for why some very strong metals are made impractical because of their brittleness has led to the study of atomic structures on the surfaces of the microscopic crystals which form the metals. It is at these surfaces, called grain boundaries, where slippage occurs, causing a material to be brittle and break under stress. A study of the migration and position of certain impurities at these surfaces, aided in part by positron diagnostics, has led to a process which increases