Transfer in ultrahigh vacuum
Another Canadian first

A new NRC device can transfer materials under study from one ultrahigh vacuum analytical chamber to another, keeping the materials at ultrahigh vacuum at all times.

Theoretical calculations suggest a vacuum in outer space as low as 10^{-20} torr — almost one hundred million billion times less than atmospheric pressure on earth. Not surprisingly, then, research in ultrahigh vacuum technology (defined as pressures below 10^{-9} torr) was accelerated after the successful launching of the Russian Sputnik in 1957.

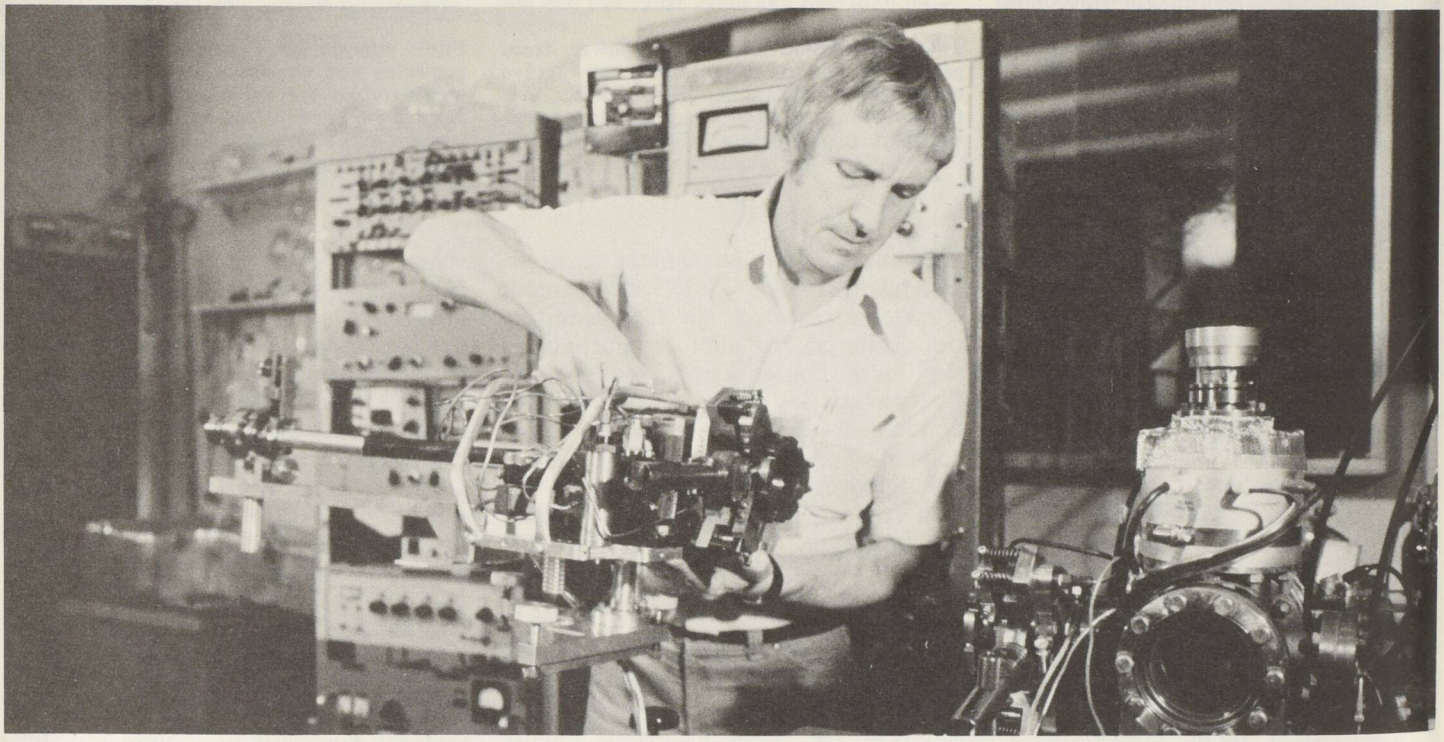
One of the early achievements in ultrahigh vacuum technology stimulated by the space program was an NRC invention, a magnetic ultrahigh vacuum gauge. It accompanied the American Apollo spaceships to the moon. Recently, NRC scientists have succeeded in another coup; they have built a device which can transfer materials from one area of ultrahigh vacuum to another, keeping the materials at ultrahigh vacuum at all times.

A vacuum, simply, is the absence of air or other gases in a particular area (the vacuum in an electronics tube is created by pumping the air out and sealing it). The degree of vacuum that can be generated depends on the sophistication of the pumping equipment, and its measurement is based on the atmospheric pressure at sea level: 1 Atmosphere, or, in scientific terms, 760 torr. We can measure accurately down to 10^{-12} torr, a pressure still far removed from the vacuum in outer space which is one hundred million times beyond the capability of our best gauges.

Another area besides the space program which requires ultrahigh vacuum technology is the science of surface physics, or the study of the structure and properties of surfaces. These investigations may be directed at determining such things as the corrosive properties of metal tubing, the structure and properties of space materials, or the effect of neutrons and other subatomic particles on nuclear reactor walls. A prerequisite for these studies is a completely controlled environment, one that will not change the material's properties while under investigation. This means that the object of study must be maintained strictly free from atmospheric gases which can deteriorate the surface by chemical interaction or by adsorbing to it.

What makes these studies logistically complex is that several different methods of investigation are required to properly evaluate the properties of a surface. One such method is to bombard the material with ions that chip away the surface one atom at a time and analyze the products. Another is to examine the material's reflective properties when exposed to low energy particles. Many other more complicated procedures are also used.

Most of the equipment for the various testing procedures has to be housed in ultrahigh vacuum chambers to keep the object under study isolated



Bruce Kane, NRC/CNRC

The uhv target transfer device (above), designed in the Division of Electrical Engineering, allows scientists to transfer samples under study from one uhv analytical instrument to another, maintaining the ultrahigh vacuum at all times. Light enough to be carried by hand, the uhv target transfer device is suitable for transporting materials between the zero gravity of the Space Shuttle and Earth. The transfer device has been licensed for manufacture to Canadian Vacuum Equipment Ltd. of Montreal. With the aid of a PILP grant from NRC, the company is currently constructing 3 units for distribution and evaluation at Laval and McMaster universities and NRC.

Le dispositif de transfert de cibles dans l'ultravide, suffisamment léger pour être déplacé à la main, permet de transporter des échantillons à bord de la navette spatiale qui, lorsqu'elle est satellisée, se trouve dans un milieu d'apesanteur, puis de les ramener à Terre. Ce dispositif de transfert sera fabriqué sous licence par la Canadian Vacuum Equipment Ltd., de Montréal. Grâce à une subvention accordée dans le cadre du programme PPIL du CNRC, cette compagnie construit actuellement trois unités destinées respectivement à l'Université Laval, à l'Université McMaster et au CNRC qui se chargeront de leur faire subir les essais nécessaires.