Meetings

Vacuum: Measurement Techniques and Equipment

New developments in the various aspects of vacuum technique were reported at the 11th national symposium of the American Vacuum Society, held 30 September to 2 October in Chicago, Illinois.

One session of the symposium consisted of invited papers on "high-energy machines." R. B. Neal of Stanford University described the 2-mile linear electron accelerator now under construction. Proposed electron-positron storage rings were discussed by G. E. Fischer of the Cambridge Electron Accelerator and by L. Malter of Varian Associates (for Laboratori Nazionali di Frascati, Italy), and a proposed proton storage ring was described by E. Fischer of the Centre Européenne de la Recherche Nucléaire. In storage rings it is important that the charged particles be stored for time periods of around 24 hours. The achievement of such long storage times imposes severe requirements (pressures on the order of 10^{-9} torr and below) for the vacuum conditions inside the storage rings. Particularly in the case of an electron-positron storage ring, the charged particles lose energy at a significant rate through synchrotron radiation as they travel around the ring. This energy, which must be continually replaced by an independent supply of radio-frequency power, impinges in a concentrated manner upon portions of the internal surface of the storage-ring envelope and causes large-scale release of gas molecules.

Both G. E. Fischer and L. Malter reported on theoretical models and experimental measurements relating to the desorption of gas under the influence of synchrotron radiation. The main direct effect of the synchrotron radiation impinging on a surface is the production of energetic photoelectrons (rather than the direct release of gas by photodesorption). By virtue of the magnetic fields associated with storage rings, these electrons strike nearby portions of the surface and cause gas desorption. Quantitative measurements of this desorption were reported. It was concluded that with proper choice of envelope materials and processing and pumping methods, the gas desorption rates could be held to completely acceptable levels for satisfactory storage ring operation.

Other papers dealt with various aspects of gas desorption under electron bombardment. In particular, R. E. Clausing of the Oak Ridge National Laboratory described measurements on "electronic cleaning" of surfaces by bombardment with electrons ranging in energy from a few electron volts to several ten thousands of electron volts. The yields obtained (number of gas molecules desorbed per incident electron) depend on many factors, including electron energy and degree of contamination on the surface.

Over the past several years, a number of developments in the field of getter-ion pumps have taken place. In pumps of this general type, chemically active gas molecules are removed by combining with a getter material, usually titanium, while the chemically inert gases are pumped by ionization and subsequent ion burial in selected areas within the pump. A new type of getter-ion pump, known as the "orbitron pump," was described by R. G. Herb, J. C. Maliakal, R. D. Welton, and R. I. White of the University of Wisconsin.

The orbitron pump consists of a pair of concentric electrodes and a thermionic electron source. The inner electrode comprises a small-diameter rod of refractory metal, such as tungsten, onto which one or more titanium cylinders of somewhat larger diameter are attached. A positive potential of several or many kilovolts is applied to this inner electrode. Electrons from the thermionic emitter are injected with sufficient angular momentum that they orbit around the inner electrode many times before being collected on the titanium cylinders. The relatively great path lengths of the orbiting electrons lead to efficient generation of positive ions, particularly when compared with the "evapor-ion" pump, which had been developed earlier by Herb and his co-workers. Collection of electrons by the titanium cylinders results in heating of the cylinders. By adjusting the input power, the temperature of the titanium can be raised so that desired rates of titanium sublimation are achieved. Although interesting performance data were reported, the extent to which orbitron pumps will be used in the future remains to be determined.

Cryopumping as a technique for pressure reduction in vacuum systems has been evolving for several years. For cryopump temperatures in the range 4° to 20°K, all gases except hydrogen and helium are pumped rapidly at pressures in the ultra-high vacuum range. Significant improvements in the pumping of hydrogen and helium can be achieved through the use of "cryosorption" pumping. The difference between cryosorption pumping and cryopumping is one of degree. In both cases, physical adsorption of gas onto chilled surfaces is responsible for the removal of gas from the vapor phase. In the case of cryosorption pumping, the surface area available for gas adsorption is increased by several orders of magnitude through the use of such sorbent materials as activated charcoal and molecular sieve.

A major problem in the use of sorbents is that of chilling the material. One approach to the solution of this problem was described in papers by J. R. Pitlor, J. P. Simpson, and A. J. Westbrock of the Linde division of Union Carbide, and by R. E. Southerlan of ARO, Inc. In this approach, molecular sieve is bonded to a metal base for the purpose of effecting improved heat transfer. It was reported that high pumping speeds are found for hydrogen at temperatures of 20°K and below. Helium is also pumped at significant rates at temperatures near 4°K. It was also reported by R. E. Southerlan that both water frost and CO_2 frost are effective in pumping hydrogen at temperatures near 20°K.

The use of low-energy electron diffraction as a tool for studying sur-

faces [see A. V. MacRae, *Science* **139**, 379 (1963)] appears to be growing rapidly. A general description of the technique and a discussion of the interpretation of diffraction patterns were given in an invited paper by W. T. Peria of the University of Minnesota. Recent developments in the technology and apparatus of low-energy electron diffraction were described by C. W. Caldwell, Jr., of the Bell Telephone Laboratories and by J. C. Helmer of Varian Associates. A paper by J. Morrison of the Bell Telephone Laboratories described the use of low-energy electron diffraction in studying the epitaxial growth of some Group III and Group IV elements on a (111) surface of silicon.

The use of mass spectrometers for partial-pressure measurements in vacuum systems has steadily increased in the decade since Alpert and his colleagues first employed the omegatron for residual gas analysis. This improvement in technique was reflected in the many papers describing experiments which included mass analysis. Realization of the inadequacy of total pressure measurements has lead to much developmental work on many types of analyzers. What one would like in such an instrument is high sensitivity—that is, easily measured outputs at the lowest partial pressures—with moderate resolution, for example, adjacent mass separation up to 100 atomic mass units. In addition, the ion source should be an open structure in order to allow gas molecules to enter the ionizing electron beam with a minimum number of collisions with solid surfaces. Several instruments, including magnetic deflection and radio-frequency instruments, have been demonstrated to be capable of satisfying these requirements. The "monopole" analyzer, a recent variation by von Zalm on the quadrapole, has additional advantages of not requiring either a magnetic field or onerous electronics. J. B. Hudson, of Rensselaer Polytechnic Institute and General Electric, and B. A. Wightman, of the Canadian National Research Council, reported very promising results with monopole analyzers. Partial-pressure sensitivity better than 10^{-12} torr was achieved using an electron multiplier detector. Scan speed is only limited by the time of flight of ions through the analyzer region (approximately 10 μsec).

At the annual banquet of the Society John C. Lilly of Communications Research Institute provided a welcome change from the preoccupation with vacuum, and introduced the audience to a novel and very interesting field of scientific activity with his talk on "The Bottle-Nosed Dolphin."

GEORGE H. BANCROFT
W. J. LANGE
R. L. JEPSEN
American Vacuum Society, Box 1282, Boston 4, Massachusetts

Psychological Testing and Public Responsibility

The subject of psychological testing is of both historical and current interest. The Army alpha and beta tests used in World War I represented the first large-scale application of testing. In the next two decades, the test movement expanded both in the range of subjects covered and in psychometric theory. During World War II millions of Americans were tested for various aptitudes and abilities as they were processed into military service, and in the last twenty years psychological assessment has become commonplace. With the rapid growth of psychological testing there has been concern on the part of both the public and professional psychologists that standards and practices be at an appropriate level. It cannot be emphasized too often that many aspects of an individual's life may be affected by testing programs. These developments were outlined by Launor Carter in his introductory speech at a symposium on psychological tests and public responsibility sponsored by the Board of Professional Affairs of the American Psychological Association.

At the symposium a report on a study of "American attitudes toward intelligence tests" being conducted by the Russell Sage Foundation was presented by Orville G. Brim, Jr. In this study the opinions of 1500 adults and 10,000 high school students regarding tests have been collected. One question asked was:

"Given tests as they are now, do you think it is fair (that is, just) to use intelligence tests to *help* make the following decisions?"

To decide who can go to certain colleges?
To put children into special classes in school?
To decide who should be hired for a job?
To decide who should be promoted?

Brim reported, "If one asks a representative group of Americans over eighteen these questions he finds that many of them are against the use of intelligence tests. Forty-one percent are opposed to using tests to help decide on admission of students to colleges; 37 percent are against using tests in job selection, and 50 percent against their use to help decide on job promotion; about one-fourth of the adult population is opposed to using intelligence tests to help establish special classes in school. One might expect that a younger group of respondents having had more experiences with tests would have more favorable attitudes. This is not true. High school students in the United States are more strongly opposed to the use of intelligence tests than is the adult population. Thus, 54 percent think it unfair to use tests to help select students for colleges; 53 percent are against using tests in job hiring; and 62 percent against their use in deciding on promotion; almost half are opposed to using intelligence tests even to help in establishing special classes in schools."

Brim pointed out that there were a number of reasons for this opposition to the use of standardized ability tests. He listed the following.

First is the problem of the confidentiality of test data. Many professionals feel that test scores should not be made available directly to the student or parents on the grounds that such data need to be interpreted by professionally trained personnel before their significance can be assessed. On the other hand, many parents and children feel that they have a right to test data and that it is often denied them.

The second criticism concerns the invasion of privacy. Although professionals may assure those taking tests that the information obtained will be held confidential, there have been instances where confidentiality has not been maintained. It is also sometimes felt that no one has the legal and ethical right to ask the type of questions that have been included in some inventories.

A third objection to tests is their use early in the life of an individual to determine various educational or career opportunities. Rigid use of test