

History of the American Vacuum Society and the International Union for Vacuum Science, Technique, and Applications

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History of the American Vacuum Society and the International Union for Vacuum Science, Technique, and Applications

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On the 30th anniversary of the American Vacuum Society, the Vacuum Technology Division presented a session on the History of Vacuum Science and Technology. The author was asked to present a paper on the history of the AVS and the IUVSTA for this session. Topics selected for discussion include the formation, growth, organizational structure, and strategy of operation of the AVS. Other subjects covered are publications, scholarships, and the author's own personal experience in setting up two major awards for the Society. For a more comprehensive and detailed history of the AVS, the reader should consult "The First Twenty Years of the American Vacuum Society" [J. Vac. Sci. Technol. **10**, 833 (1978)] and "The American Vacuum Society—1973 to 1983" [J. Vac. Sci. Technol. A **1**, 1351 (1983)]. Other countries have also organized their own vacuum societies. Many of these, some 22 in number, including the AVS, are members of the IUVSTA, an international confederation of national vacuum organizations. The formation and early history of this organization is described, including its new scientific divisions patterned after the AVS. Various objectives and activities of the Union are discussed.

PACS numbers: 01.10.Hx, 01.65. + g, 01.60. + q

I. INTRODUCTION

Vacuum research appears to have had its beginning around the middle of the seventeenth century with the discovery of the vacuum pump by the great German scientist and technologist, Otto von Guericke. Some time in the 1650's he succeeded in developing a vacuum pump with an exhaust arrangement that separated a definite volume of air from the vessel to be exhausted and gave it up to the atmosphere—the principle used in most mechanical pumps today. With this pump, von Guericke was able to exhaust quite large vessels and study the properties of vacua. He appears to have been much impressed with the magnitude of the force exerted by atmospheric pressure; many of his experiments were arranged to demonstrate this force. His most notable and highly publicized was the Magdeburg hemispheres experiment (Fig. 1), in which he put two small hemispheres together to form a sphere and evacuated it by means of his vacuum pump. Sixteen strong horses were unable to overcome the immense force of the atmosphere and pull the hemisphere apart.

From the beginning, vacua have been produced for a purpose. Scientists needed a vacuum environment in which to do research—for example, to increase the mean free path of an electron, ion or neutral-particle beam in the residual gas of some devices, or to provide an environment free of chemically active gases for surface or deposition studies. Industry's first need for vacuum was for the production of light bulbs, x-ray, and radio tubes. Whatever the reason, in the early days, vacuum technology was generally practiced by scientists and engineers who lacked training in the field, and whose main pursuits were research and technology in other fields. Under such circumstances, it was not too surprising that vacuum technology came to be known as black magic with string, Glyptal, sealing wax, and all the rest.¹ It was clear that professionalism was lacking in the practice of

vacuum science and technology and that there was a need for a technical society devoted exclusively to this field.

II. COMMITTEE ON VACUUM TECHNIQUES

The person who apparently first recognized the need for a professional vacuum society, or at least did something about it, was Frederick A. McNally, a young scientist with the Jarrel-Ash Company. Through his efforts, an organizational meeting was held in New York on 18 June 1953, to discuss the formation of a permanent organization that could bring together both the theoretical and practical knowledge of the many different fields using vacuum as a production or research tool. This meeting resulted in the formal organization of the "Committee on Vacuum Techniques" less than a week later, and its formal incorporation in Massachusetts on 19 October 1953. Since its first symposium the following June in Asbury Park (New Jersey), with 35 papers and 295 registrants, the group has convened an annual symposium in every succeeding year.

III. THE AMERICAN VACUUM SOCIETY

In 1957, the CVT changed its name to the American Vacuum Society, Inc. The first biennial equipment exhibit was held in conjunction with its 1961 symposium. Since 1965, an equipment exhibit has been a part of every symposium. These exhibits have proved to be of great interest to the registrants, and of considerable financial help to the AVS. More than 1300 attended the 30th National Symposium in Boston in 1983, and over 400 papers were presented there.

The AVS had continued to grow (Fig. 2) and prosper, reaching a peak of over 3200 members in 1968. Its membership then declined to less than 2200 by 1982 following government cutbacks in the space and other R & D programs. During the past seven years, however, the AVS has started to grow again at an almost constant rate of about 435 members per year. Its current membership exceeds 5000.

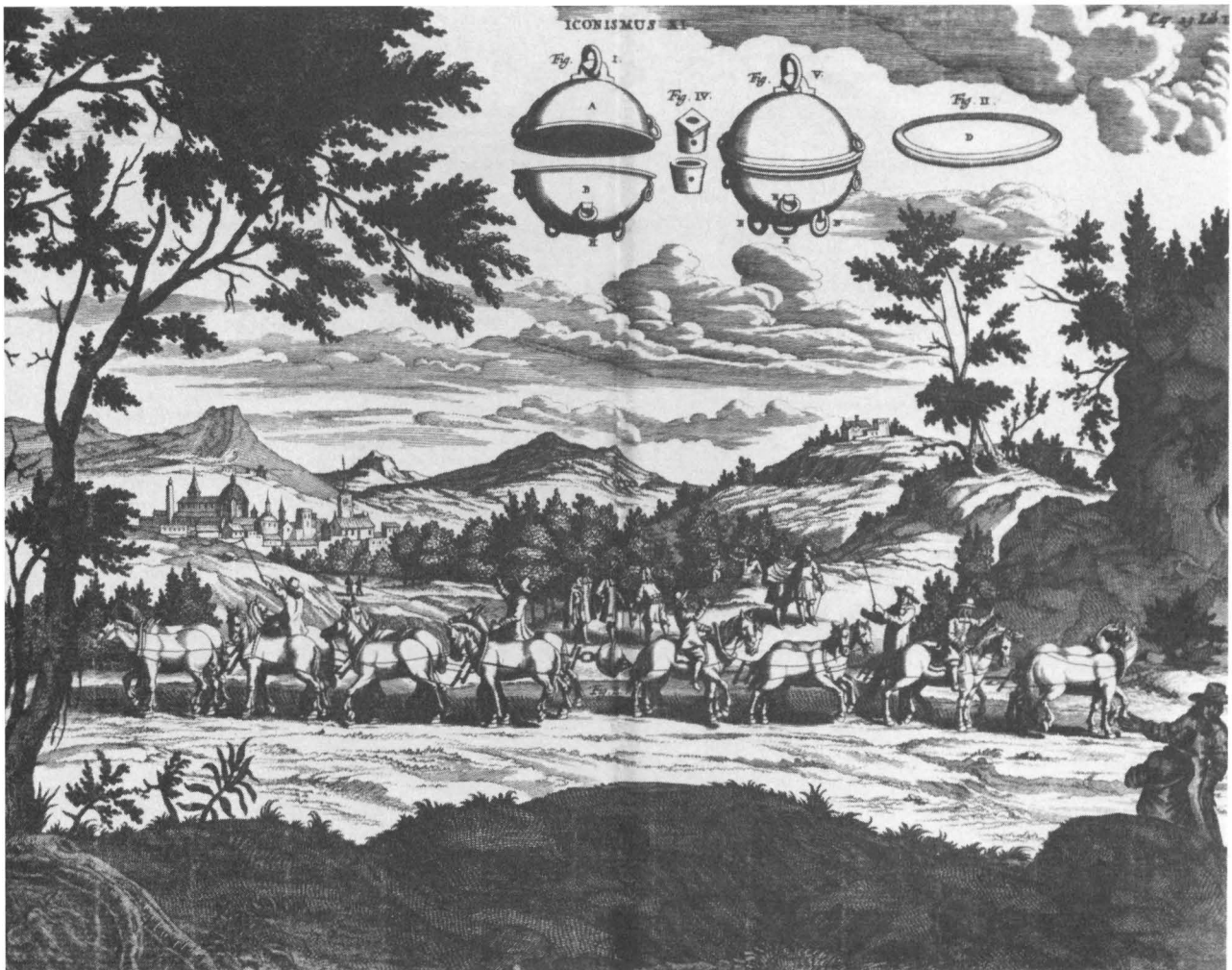


FIG. 1. In von Guericke's experiment demonstrating the immense force of the atmosphere, 16 horses were unable to separate the evacuated Magdeburg hemispheres.

Over the years, the AVS has developed a close association with the American Institute of Physics. In April 1963, it became an affiliate of AIP, and a full member society in 1976. The AIP has been publishing the *Journal of Vacuum Science and Technology* for the AVS since its inception in

1965. The Institute also has managed the equipment exhibits at the national symposia since 1965. In December 1967, AVS moved its offices from Boston to the AIP building in New York City, and in May 1968, a full-time Executive Secretary, Nancy Hammond, was engaged by AIP for the Society. In 1979, the AVS office expanded to include word-processing equipment and another full-time employee. In 1981, a Meetings Manager, Marion Churchill, was employed to manage the nontechnical aspects of the National Symposia and the short course operations. The modern large-scale facilities of the AIP for publishing and for society membership processing have been very beneficial to the AVS.

IV. AVS DIVISIONS AND CHAPTERS

The AVS is governed by an elected Board of Directors consisting of a President (Fig. 3), President-Elect, Secretary-Clerk, Treasurer, and six Directors. Three directors are elected each year and they serve a two-year term.

If, in the 1960's, the AVS Board of Directors had insisted on limiting their interests to the production and measurement of vacuum, it is doubtful whether the Society would be in existence today. At best, I suspect, it would have a greatly diminished level of activity. Instead, the Board formed new divisions to provide a home and give support to those new

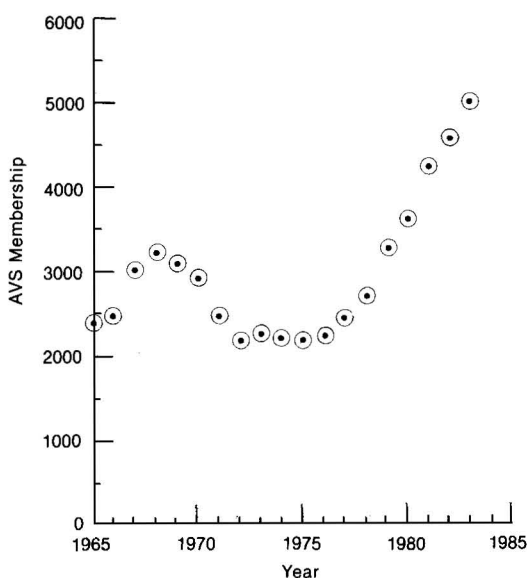


FIG. 2. American Vacuum Society membership since 1965.

American Vacuum Society Presidents, 1953-83



1953-54 J.B. Merrill	1954-55 R.A. Koehler	1955-56 J.R. Bowman	1956-57 A. Guthrie	1957-58 M.W. Welch	1958-59 A.J. Gale
1959-60 W.G. Matheson	1960-61 B.B. Dayton	1961-62 L.E. Preuss	1962-63 D.J. Santeler	1963-64 C.H. Bachman	1964-65 G.H. Bancroft
1965-66 H.A. Steinherz	1966-67 H.W. Schleuning	1967-68 P.A. Redhead	1968-69 J.M. Lafferty	1969-70 W.J. Lange	1970-71 R.F. Bunshah
1971-72 D.G. Bills	1973 M.H. Francombe	1974 D.M. Hoffman	1975 L.W. Hull	1976 N.R. Whetten	1977 R.W. Hoffman
1978 L.C. Beavis	1979 C.B. Duke	1980 J.L. Vossen	1981 T.E. Madey	1982 J.A. Thornton	1983 J.R. Arthur

FIG. 3. Presidents of the AVS, 1953-83.

disciplines that had benefited most from improved vacuum technology. These included a Vacuum Metallurgy Division in 1961, a Thin Film Division in 1964, a Surface Science Division in 1968, and Electronic Materials and Processes Division in 1979 and a Fusion Technology Division in 1980.

To keep the tail from wagging the dog that started all of this, the vacuum technologists, in self-defense, formed a home for themselves by setting up their own Vacuum Technology Division in 1970.

The divisions provide technical guidance to the Society. They play a strong hand in the content of the National Symposia and they sponsor or co-sponsor topical symposia related to their own special fields of expertise. New divisions will undoubtedly be formed in the future as new scientific and technological areas develop that are related to vacuum.

It will be noted that even though the AVS has now become a multidisciplinary society, there is a synergistic interaction between the divisions that extends beyond the fact that they all use vacuum as an important tool in practicing their trade. This has given the Society strength and tenacity.

Local Chapters are a vital part of the AVS structure and have contributed substantially to its growth. They are geographical in nature and serve to bring important technical information to local communities on a continuing basis through the year between the annual National Vacuum Symposia. This is done through regional symposia, courses, newsletters, dinner meetings, etc. The first Chapter, Pacific Northwest, was organized in the Seattle area in 1962. Since then, the chapters have grown to 21 in number throughout the United States and in Canada. The latest chapter formed was Texas in 1981.

V. AVS SERVICES AND AWARDS

In addition to its annual National Vacuum Symposia and the publication of its own journal, the AVS has been very active in promoting vacuum education by publishing monographs and teaching courses at both the apprentice and advanced theory levels. Its Short Course program alone has become a major operation with a cash flow of nearly one-half million dollars annually, thanks to the pioneering efforts of Vivienne Harwood. The Society publishes a Membership Services Booklet, a biennial Membership Directory and a bimonthly newsletter. It has an active Standards Committee, which has published many of its own standards and helped in developing national and international vacuum standards. The AVS also has established grants, graduate scholarships, and major awards in vacuum science and the related fields covered by its divisions.

Since I was intimately involved in setting up two of these major awards, perhaps the readers will allow me to digress for a moment to describe my own personal experiences on this subject. In 1969, it occurred to me that the AVS should establish an award to recognize and encourage outstanding theoretical and experimental research in vacuum science and related fields of interest to its divisions. I had in mind that the award should consist of a gold medal, certificate, and a monetary prize and that it would be called the *Saul Dushman Award* in honor of the grand old man who in 1949

published the classic book, *Scientific Foundations of Vacuum Technique*. As it turned out, financial support for the award was not forthcoming from his institution and I turned to the AIRES Institute through Luther Preuss, a close friend of the M. W. Welch family. This approach was more successful. The Institute contributed funds for ten \$1000 awards and later contributed an additional \$9000.

M. W. Welch had long been a close friend of the AVS, participating in its formation, and later serving as its president in 1957–58. To commemorate his pioneering efforts in the founding and support of the Society, it was decided to call the award *The Medard W. Welch Award*. I accordingly laid out a design for a gold medal (Fig. 4) with a profile of Medard W. Welch on one side and the classic scene of the Magdeburg hemispheres (Fig. 1) on the reverse side. Luther Preuss engaged the Weyhing Brothers in Detroit, Michigan to fabricate the dies for the metal. The first medal struck was given to M. W. Welch in appreciation for his founding the award.

The monies from the AIRES Institute were placed in a separate interest-bearing account and the interest was used to defray the cost of the metals. In 1978, the AVS Board of Directors adopted a policy of paying the travel costs of the award recipient to attend the National Vacuum Symposium at which the presentation was to be made. In memory of M. W. Welch, who died in 1980, the Board established an additional endowment to ensure that the gold medal associated with this award could be given in perpetuity.

In 1972, when I was chairman of the Awards, Grants, and Scholarships Committee, I had the pleasure of presenting the Welch Award to Kenneth C. D. Hickman (Fig. 5) for his outstanding research and development related to vapor pumps and their working fluids and for his invention of the self-fractionating vapor pump. Hickman had always been a very active participant in the AVS technical programs and had a keen interest in the Society. It was not long after he received the Welch Award that Hickman approached me on the subject of establishing another major AVS award. He did not want it to detract from the Welch Award and had in mind that it should recognize and encourage outstanding *single* discoveries or inventions in fields of interest to the AVS. He also stipulated that the award should be conferred



FIG. 4. The gold medal given with *The Medard W. Welch Award*.



FIG. 5. A photograph taken at Chicago in 1972 on the occasion of the presentation of *The Medard W. Welch Award* to Kenneth C. D. Hickman by James M. Lafferty, Chairman of the Awards, Grants, and Scholarship Committee. Mr. Welch, founder of the Award, is in the center of the photo and Dr. Hickman is on the right.

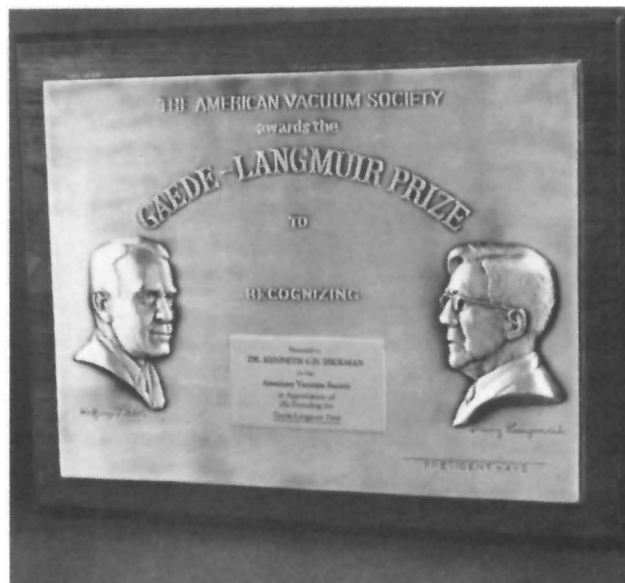


FIG. 6. The first Gaede–Langmuir plaque given to Kenneth C. D. Hickman by the American Vacuum Society in appreciation of his founding *The Gaede–Langmuir Prize*.

only when an outstanding candidate appeared and in no case more than once every two years. He also had in mind that the award should be called a *prize* to distinguish it from the *Welch Award*. In addition to a \$2000 cash prize, there should be a plaque with the citation for the award inscribed on it that could be displayed rather than a gold medal to be tucked away. We had many long discussions on what the prize would be called. He finally decided on *The Gaede–Langmuir Prize* because he felt that these two men were eminently successful in exemplifying the type of accomplishments that should be recognized in awarding the new prize. Hickman decided that the plaque should be made of antique silver and there should be a bust of Gaede and Langmuir facing each other from opposite sides. The details were left up to me. The biggest problem I had was finding a photograph of Professor Wolfgang Gaede for the sculptor at Medallion Arts Company whom I had engaged to design the plaque. This was finally found with the help of my good friend, Professor Dr. Günter Ecker, at the University of Bochum in Germany. The first plaque (Fig. 6) produced was given to Hickman in appreciation of his founding *The Gaede–Langmuir Prize*. The prize was first awarded in 1978 to Professor Pierre V. Auger.

The Board of Directors also provides the recipients travel expenses to receive the prize.

Hickman had stipulated that the founder of *The Gaede–Langmuir Prize* should remain anonymous during his lifetime. After a brief illness, he died on November 3, 1979.² In consultation with Mrs. Eleanor Hickman, it was agreed that it would be appropriate to reveal the founder of *The Gaede–Langmuir Prize* on the occasion of the 30th anniversary of the American Vacuum Society.

VI. THE INTERNATIONAL UNION FOR VACUUM SCIENCE, TECHNIQUE, AND APPLICATIONS

Other countries have also organized their own vacuum societies or national committees on vacuum. Many of these,

some 22 in number (including the AVS), are members of the International Union for Vacuum Science, Technique, and Applications.

The Union had its origin in June 1958 in Namur, Belgium under the leadership of Professor Emil Thomas at a meeting called the “Premier Congres International pour L’Etude des Techniques du Vide.” At this meeting, the International Organization for Vacuum Science and Technology (IOVST) was structured with Professor Thomas as president. The IOVST accepted an invitation from the AVS to hold its second International Congress in Washington, D.C. in combination with the 8th National Vacuum Symposium of the Society in 1961. An equipment exhibit was also held for the first time during this meeting. The exhibit proved to be very successful from both a technical and financial point of view for both organizations.

On December 8, 1962 in Brussels, Belgium the IOVST was dissolved and a new constitution was set up with the formation of the International Union for Vacuum Science, Technique, and Applications (IUVSTA). All the assets and records of the IOVST were transferred to the new organization and Medard W. Welch, who played a leading role in its formation, was chosen to be its first president. At this time, vacuum groups from 13 countries were members of the Union. The essential difference between the IOVST and the new IUVSTA is that the old organization was based upon individual members in the various countries; whereas now each country is represented by a councilor. The councilor presently representing the AVS is L. C. Beavis.

In its present form, the IUVSTA is an international confederation of national vacuum organizations and excludes private membership. It was organized to promote vacuum science and technology on an international level. This includes promotion of education and research and the establishment of international standards for nomenclature, measuring techniques, and fittings on vacuum equipment. The

IUVSTA encourages the establishment of national vacuum committees (societies) in countries where they still do not exist and helps coordinate the activities of the national committees.

The IUVSTA organizes an International Vacuum Congress every three years. Since 1971, this Congress has been held in conjunction with the International Conference on Solid Surfaces which was initiated by the AVS Surface Science Division. The latest Congress was held at Madrid, Spain in September 1983 with nearly 1000 in attendance. Two earlier Congresses were held jointly with National Vacuum Symposia of the AVS in 1961 and 1971, and a third one is planned for 1986 in Baltimore.

The IUVSTA publishes a quarterly News Bulletin that is sent to its member National Committees and others to inform them of the activities of the Executive Council and the Divisions. It also contains a calendar of events and other articles of international interest. Starting in 1984, J. L. Provo, editor of the AVS Newsletter, will be the new editor of the IUVSTA News Bulletin. The AVS has agreed to handle the publication and mailing of the Bulletin at cost from their office in New York, taking advantage of the large-scale automated publication facilities of the American Institute of Physics.

The interests of the IUVSTA encompass not only vacuum *per se*, but those disciplines that use vacuum as an important tool. Like the AVS, the Union has established divisions in surface science, thin films, vacuum science, electronic materials and processing, and fusion. These divisions will now play an active role in the organization of the technical program of the triennial congresses and conferences. This was done for the first time at the Madrid meeting. All of the divisions worked together with the Spanish Congress organizers in an International Advisory Committee. They had an important role in the selection of scientific papers, in the selection of invited speakers and of moderators for the different sessions at the meeting which were divided on the basis of the Union's divisional structure.

The IUVSTA serves as a "clearing house" for the organization of international congresses and conferences on vacuum and related fields by granting sponsorship for these meetings. The formalities of the sponsorship requests are handled by the Secretary-General,³ but divisional approval is also required. The purpose of the sponsorship is to avoid date conflicts and coordinate international meetings in fields of interest to the Union.

VII. THE M. W. WELCH INTERNATIONAL SCHOLARSHIP

In 1965, M. W. Welch made a proposal to the AVS Board of Directors for the establishment of a \$5000 international scholarship to be used for postgraduate study in vacuum science and technology. Under the terms of the proposal, the AVS would be custodian of the funds, advancing \$5000 each year to the IUVSTA on the acceptance of a satisfactory protocol describing how it would select the scholars. A protocol was accepted in 1966 and the first scholar was chosen in 1968. A scholar has been selected each year since then and the Welch family has continued to advance money annually to support the scholarships. The amount of the scholarship was increased to \$7000 in 1974. On the establishment of an Executive Secretariat by the IUVSTA in London in 1971, all administrative chores associated with the Welch Scholarship were transferred to that office. On the demise of the Secretariat in 1980, for economic reasons, the administrative work was returned to the AVS and is now managed by a Scholarship Administrator, J. P. Hobson. Under the present protocol, revised in 1980, the Scholarship Administrator is responsible to the Welch Foundation consisting of the Director of the Scientific and Technical Directorate of the IUVSTA who serves as *ex officio* chairman and four "IUVSTA Welch Scholarship Trustees" elected by the Executive Council of the IUVSTA.

VIII. CONCLUSION

The unprecedented growth of the AVS during the extended period of the past seven years in a period of economic stagnation can only mean that the Society must be doing something right. In my judgment, what it is doing is to provide a needed service to the scientific and engineering community in selected areas related to vacuum, some of which are growing much more rapidly than the national economy.

The IUVSTA should prosper also now that they have their finances under control and continue to develop the technical related activities of their new Divisions.

ACKNOWLEDGMENT

The author wishes to express his appreciation to Nancy Hammond for her help in obtaining the photographs for Fig. 3.

¹J. M. Lafferty, *Phys. Today* **34**, 211 (1981).

²J. M. Lafferty, *J. Vac. Sci. Technol.* **16**, 2117 (1979).

³H. Jahrreiss, *IUVSTA Information Booklet*, 2nd ed. (1981).