Meetings

Crystal Films

In recent years a considerable amount of technical and scientific literature has been published on the subject of thin films. Much of this has dealt with physical (electrical, magnetic, and optical) properties and with the evaluation of films for solid-state components. In order to discuss various aspects of this complex field, a conference was held at Philco Scientific Laboratory, Blue Bell (13–15 May). Scientists from the United States and abroad attended the meeting.

In one important class of materials (for example, semiconducting elements and compounds), films in single-crystal epitaxial form have found wide utility, and their properties in relation to the needs of active devices have been fairly well characterized. The present trend in electronics technology, however, is toward devices which comprise combinations of films such as metals and insulators that possess a variety of special characteristics (for example, magnetic hysteresis, high dielectric capacitance, superconductivity, and so forth). Although the tailoring of these film components to the requirements of microcircuit assemblies is often critical, our knowledge of the factors that govern their behavior is still very obscure.

The conference, with reference to its bearing on the technology of solid state components, was concerned with the following main themes: (i) the problems of how those films commonly used in the fabrication of new devices nucleate and grow on both amorphous and single crystal surfaces, (ii) the need for clean surfaces and high vacuums in order to obtain reproducible growth and structural data on thin films, particularly those with single-crystal structures, (iii) novel preparative techniques such as cathodic sputtering and flash vaporization suitable for the epitaxial growth of semiconductors or alloys in standard vacuum systems, and (iv) the need for making physical measurements on single-crystal films which are as free from structural defects as possible. Such measurements may prove vital in arriving at a systematic evaluation of the ultimate potential of thin films in new miniature components.

Detailed discussions dealt with general problems of the initial nucleation and growth of thin films of various materials ranging from metals to insulators and compound semiconductors. New theoretical and experimental work on the potency of macroscopic steps as nucleation catalysts was cited. Recent experiments which provide new evidence on the role of substrate perfection and atmospheric contamination were described, and new data were presented on the electrical, optical, and magnetic properties of single-crystal films grown by epitaxy on crystal substrates.

It is anticipated that the conference will play an important role in highlighting the fundamental problems of thin-film structure and in demonstrating the importance of making physical measurements on films in which the structural orientation and perfection are properly characterized. Sponsors of the meeting included: Advanced Research Projects Agency, Office of Naval Research, Philco Corporation, Princeton University, and the University of Pennsylvania.

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Surface Physics

A group of scientists interested in the physics of surfaces heard four invited speakers present papers on their latest work at a symposium at Washington State University (17–18 May).

Even though "vacuum measurements" were not presented, it is inevitable when vacuum workers get together that thoughts turn to pressure measurements and the accepted standard at low pressure—the Bayard-Alpert ionization gauge. Alpert developed the inverted gauge structure in 1950 and showed that the low pressure limit was reduced from 10^{-8} to 10^{-11} torr by reducing the collector size and the corresponding photoelectric effect at the collector. He showed that the improved performance at low pressure was still limited by a small photoelectric current caused by x-rays striking the collector.

The Bayard-Alpert gauge is simple in principle and in operation; electrons collide with gas molecules, and the resulting ions are collected. The collector current is proportional to the pressure in the gauge if precautions are taken to keep constant the electron current, gas composition, fields, and so forth. Recent unexplained or anomalous nonlinear behavior has been noted for these gauges when they are operated at low pressures in the presence of active gases. Two of the papers at this symposium suggested possible causes of this behavior.

P. A. Redhead (National Research Council of Canada) spoke on the interaction of electrons with chemisorbed layers of gases. He has found that when electrons bombard a molybdenum surface covered with oxygen, ions of oxygen are released with an efficiency of 10^{-5} ion per electron, while neutral oxygen is released with an efficiency of 10^{-3} atom per electron. If ions were released from the grid of an ionization gauge by this mechanism, they would register as ion current and make the gauge reading incorrect.

D. R. Denison (Washington State University) described another effect which may produce incorrect ionization gauge readings. He showed that when a filament is heated in active gases, it is chemically sputtered and releases positive ions and neutral impurity atoms originally present in the filament. The neutral atoms could travel to the grid and be desorbed later as ions by electron bombardment. This would produce a collector current not related to pressure in an ionization gauge.

Yet another possible source of contaminants is the glass wall of the gauge. Thermal decomposition or physical sputtering of the glass could deposit impurities on the grid from which they may later be desorbed as ions. All of these effects show that the low pressure limit of the Bayard-Alpert ioniza-