PHYSICS

Chairman: K. W. MEISSNER, Purdue University

Dr. B. A. Howlett, Rose Polytechnic Institute was elected chairman of the section for 1947.

ABSTRACTS

Interference spectroscopy. K. W. MEISSNER, Purdue University.—The application of interference phenomena in spectroscopy which was originated by Fizeau and further developed by Michelson, Perot, Fabry, and Buisson is of greatest importance for: (1) Absolute wave length measurements (Primary Standard), (2) Wave length measurements relative to the primary standard (Secondary Standards), (3) Study of intensity distribution in spectral lines, and (4) Special problems calling for such high resolving power which cannot be obtained with grating or prism spectroscopes.

The Interferometer of Perot and Fabry exhibits great advantages. It is simple in principle, not too expensive, and its resolving power can be adapted to the need of the special problems and can reach such an amount as never obtained with other spectroscopic instruments. Its application is more difficult than that of other spectroscopes but the evaluation of the interference patterns is rather simple. In combination with a prism or grating instrument it can be used for the study of spectra rich in lines.

If the eye piece of the spectroscope telescope is provided with an ocular micrometer the interferometric outfit is very useful for demonstration and instruction. Especially the determination of small wave length intervals is carried out very easily by measuring the diameters of a few consecutive circular interference patterns. Thus it is very useful for the qualitiative and quantitative study of Zeeman patterns in the student laboratory. By employing Helium, Neon, and Krypton Geisler tubes one has at his disposal many typical lines exhibiting normal and anomalous Zeeman splitting. A magnetic field of about 2000 Oersted is sufficient and it is easy to study the kind of light polarization obtained with the transversal and longitudinal effect.

Methods for naming new physical concepts. DUANE ROLLER, Wabash College.—The name for an important new quantity, device or process should be chosen with careful regard for nonambiguity, meaningfulness, internationality, simplicity and euphony. Examination of numerous existing terms in the light of these general requirements leads to a set of specific rules that make the choice of suitable new terms a comparatively simple matter. Possible sources from which to obtain new technical terms are: ordinary English, modern foreign languages, classical languages, coined words, the name(s) of the discoverer(s) of the concept. Often the most satisfactory procedure is to construct the new term from parts taken from classical Greek. Experience indicates that one should be indifferent to a question of terminology only if the concept involved is superficial or highly local in character; also, curiously, if it is not likely to have important applications in industry.

Experiments on contact rectification in germanium. S. BENZER, Purdue University.—The contact rectification between metals and germanium crystals is generally explained on the natural barrier layer theory in which the current in the forward direction is limited by the spreading resistance, while the current in the back direction is limited by a barrier layer due to the difference in work function between the metal and the semiconductor. If this theory applies, two pieces of the same germanium crystal when contacted with each other should show no rectification and the current-voltage characteristic should be linear and of resistance corresponding to the spreading resistance of the contact. However, if germanium alloys of the high black voltage type are contacted this way, the resultant resistance is much higher than is to be expected from spreading resistance alone. This indicates that these crystals have an artificial surface layer which has a large effect on the rectification observed with a metal cat-whisker.

Properties of P-type germanium rectifiers. RALPH BRAY and K. LARK-HOROVITZ, Purdue University.—The unit consisting of a pointed metal wire making contact with p-type (hole-conducting) germanium has rectifying, photovoltaic, photoconductive and thermal properties, which depend on the particular metal used, and the resistivity and surface treatment of the Ge crystal. Shining light in the immediate vicinity of the metal—Ge contact greatly increases the current in the high resistance direction (metal positive, Ge negative), but produced little change in the conducting direction. This effect may be so pronounced as to make it appear that the rectification is reversed. Heating the unit produces a similar effect, the higher the resistivity of the sample the lower the temperature at which the reversal takes place. Unlike the photo effect the thermal effect is quite insensitive to what metal is used. The photo effects are most sensitive to the frequencies in the infra red portion of the spectrum. The large increase in current produced by heat and light is probably due to the excitation of electrons from the full bank of the Ge semiconductor into the empty band. The energy necessary for such excitation ocrresponds to the frequency and temperature at which these effects occur. However, the great difference in magnitude between the effects in the low and high resistance directions can not be explained by the simple theory of a natural barrier between semiconductor and metal.

The shape of semiconductor resistivity curves. V. A. JOHNSON and K. LARK-HOROVITZ, Purdue University.—If resistivity as a function of temperature is measured for a group of semiconducting samples, the curves obtained differ in shape with the nature of the sample. As temperature rises, the resistivity continually drops for one type of sample, for another type the resistivity rises to a maximum and then drops to a minimum, rises to a maximum, and then falls. This paper shows that the existence or non-existence of a maximum may be correlated with the Hall effect curve of the sample. It is shown that the position of the maximum, when it exists, may also be predicted from Hall effect data.

X-Ray investigations of germanium-tin alloys. L. DOWELL and K. LARK-HOROVITZ, Puprdue University.—Germanium alloys with small amounts of impurities do not show any differences in crystal structure as compared with pure germanium. However in samples to which 17% of tin had been added definite expansion of lattice has been found. Therefore, experiments were carried out in which starting with germanium tin alloy to which 17% tin had been added systematic dilutions with pure germanium were made. These experiments show that the lattice parameter as a function of concentration of tin changes linearly which would indicate that the tin is going into the germanium in a solid solution.

Decay of Phosphorescence in Sulfide Phosphors. HUBERT M. JAMES, Purdue University.—Many sulfides activated with impurity atoms emit phosphorescent light with intensity decreasing roughly inversely with t^2, t being the time elapsed since excitation. Certain of these phosphors, including ZnS activated by the addition of CuS, show a much more persistent phosphorescence with intensity inversely proportional to t over a large range of intensities. The inverse t^2 law of decay is understood on the assumption that the radiative process is the recombination of excited electrons with the vacancies available in the activating impurity atoms. The mechanism responsible for the inverse t law has not hitherto been understood. The slower decay of these crystals suggest that the excited electrons are trapped in the crystals, and thus prevented for some time from returning to the impurity atoms. It has been observed that large-grained ZnS gives an inverse t^2 decay, in contrast to the inverse t decay of the usual fine-grained material. This suggests that in the latter case the electrons are trapped on the extensive surfaces of the small crystals. The consequences of this assumption have been developed, and lead to a quantitative explanation of the decay of phosphorescence in Cu-activated ZnS, for times greater than 10^{-4} sec. after excitation has stopped. Deviation of observations from the theory for very small t appeared to be due to failure of the excited electrons to come into thermal equilibrium with the crystal in these very short times, whereas the theory assumes that such an equilibrium exists.

The 93 kev-γ-Line of UX_1. H. L. BRADT, Purdue University.—In the β-spectrum of UX_1 there occur L-, M-, and N-conversion lines of a 93 kev-γ-radiation. The fact that the wave-length as measured by Meitner is just the wave-length of the $K\alpha_2$ x-rays of the daughter product UX_2 suggested to Meitner that the observed β-lines are nothing but conversion lines of the UX_2-$K\alpha_2$ x-radiation. However, there seemed to be no acceptable reason for an excitation of this K-radiation. Our investigation of the β-spectrum and the γ-radiation of UX, using a magnetic spectrometer and counters of calibrated efficiencies, leads to the result that the lines occurring in the β-spectrum are, with high probability, like the similar RdTh lines (Surugue and Tsien-SanTsiang), conversion lines of a nuclear γ-radiation. The L_1-conversion coefficient of this 93 kev-γ-radition has been determined from the intensity of the L_1-conversion line (0.05_1 electons/β-decay and the intensity of the unconverted γ-radiation (0.15 quanta/β-decay) as $N_e/N_q = 0.34$, in agreement with the theoretical value for quadrupole radiation, calculated by Fisk. The upper limit of the UX_1-β-spectrum has been determined as (0.205 ± 0.01) Mev. 80 percent of all β-transitions lead to UX_2 in its normal state, while 20 percent lead to the excited 0.093 Mev. level.

Measurements on microwave accelerator cavities. R. O. HAXBY, Purdue University.—The construction of a microwave linear accelerator for electrons has been started. An eighteen section accelerating tube has been constructed using loading every ½ wavelength. Measurements of other modes showed that the only interfering mode is one having seventeen half-waves in the eighteen sections. This mode, and other odd modes, may be removed by symmetrical feeding. Experiments have been performed on tube sections with varying loading, two tubes have been constructed for use in accelerating electrons with entering velocity less than c. Measurements are now in progress on one of these tubes to determine the proper geometry for coupling it to a magnetron.

Effects of a resonant load on the performance of a magnetron. F. F. RIEKE, Purdue University.—The effects of resonant loads on the performance of a magnetron are of current interest in connection with the proposed use of magnetrons as sources of high-frequency power for electron- and ion-accelerators. An essential feature of these accelerators is a high-Q resonant cavity in which intense electric fields are produced by excitation with power from a pulsed magnetron. The combination of magnetron, coupling element (a wave-guide) and the cavity may be considered as a system of circuits, which has several normal modes of oscillation. Only one of these modes has the configuration of electric fields which is effective for the functioning of the accelerator, so that some means must be found of insuring that this mode is excited consistently at each pulse. Experience with somewhat similar systems has shown that damping resistors inserted at appropriate points in the circuit are useful in suppressing undesirable modes of oscillation.

Diatomaceous earth as test object for electron microscope. H. J. YEARIAN, Purdue University.—Diatoms have long been used as a test object in light microscopy. They also prove useful with the electron microscope. A circular opening may be used to test for double images due to poor adjustment of the instrument. A regularly perforated plate photographed at different parts of the field aids in calculating the variation of radial and tangential magnification producing image distortion. The length of a row of perforations large enough to be identified in the light microscope may be measured and compared with that obtained from a series of photographs at the larger magnification of the electron instrument, to give a magnification calibration of the latter. Some of the finer details of the structure may also enable one to estimate the resolving power of the instrument. In the course of this work a number of examples have been found of a fine lacework across openings which are just resolvable in the light microscope. This structure usually consists of small circular openings symmetrically arranged about the center of the main opening.

The Helium Spectron in the Infrared. HELEN LOWENTHAL and K. W. MEISSNER, Purdue University.—The infrared spectra of normal and ionized Helium were investigated by the use of sensitized Eastman-Kodak photographic plates. Of special interest were the following results.

The Ortho-Helium line at 10 830A which is expected to be a close triplet appeared on the spectrograms taken with a 14 foot concave grating as a double line since the splitting of the triplet P level ($j = 1$ & 2) could not be resolved. This unresolved strong component exhibited self reversal when the Geissler tube was used in "end on" position. This phenomenon is due to the metastability of the triplet S state involved. By making use of this absorption effect and by employing an interferometer definite resolution of the triplet structure was obtained. The previously unresolved components appeared now as definitely resolved absorption lines. The splitting of the P-levels was found to be: Triplet P (2,1) $= 0.078 \pm 0.002$ cm^{-1} and Triplet P (1,0) $= 0.994 \pm 0.002$ cm^{-1}. These values are in good agreement with those found by Meggers and Humphreys who measured the same line in emission.

The investigation of the ionized Helium by means of a hollow cathode light source was devoted to the study of the fundamental line of the Pickering series 10 123A the existence of which had previously been proved by Paschen and Ritschl. Although the line could be photographed with the grating and the wave length be measured (10 123.62 ± 0.02A) the study of the fine structure of this line was found to be impossible with the techniques available at the present.