PHYSICS

Chairman: B. A. HOWLETT, Rose Polytechnic Institute

Dr. J. C. Hendricks, Franklin College, was elected chairman of the section for 1948.

ABSTRACTS

The mass and density distribution in our solar system. D. TER HAAR, Purdue University.—It can be shown that every theory about the origin of the solar system can explain the difference in mass and density between the major (outer) and terrestial (inner) planets, if it starts from a situation where the sun in its present position is surrounded by a gaseous disc as first introduced by Kant. This difference in mass and density is a consequence of the fact that the gas pressure will be higher than the saturated vapor pressure of most inorganic compounds throughout the disc, while the gas will only be supersaturated for organic compounds in the colder (i. e. outer) regions of the disc. It is also possible to explain the difference in density in the series of the terrestial planets as a consequence of their different masses.

Deviations from Ohm's law in Germanium. R. BRAY, Purdue University.—Semiconductors obey Ohm's Law only at relatively weak fields. Above certain critical field strengths, which are different for different semi conductors, the conductivity increases rapidly. This critical field strength may be as high as 10^4—10^5 V/cm in CuO or as low as about 100 V/cm in selenium. Our investigations with germanium samples of resistivity near 1 ohm-cm show in this case a critical field of the order of 100 V/cm. The fields are applied in short pulses, a few microseconds in duration, in order to prevent heating of the samples. Observation of the pulses on the oscilloscope shows that the effect of the electric field is not instantaneous, but of the order of 10^{-7} seconds. For all these semiconductors, an irreversible breakdown occurs at much higher fields. None of the many proposed theories adequately explain all the observations in this field, such as the low fields at which the effects begin, the temperature dependency, the difference between semiconductors, the dependence of conductivity on field strength.

Calculation of resistivity curve for Tin doped Germanium. V. A. JOHNSON, Purdue University.—Lark-Horovitz and Dowell prepared a series of germanium samples with from one to seventeen atomic percent of tin added. These samples were studied by x-ray methods to determine the amount of tin actually taken up in the germanium lattice and the amount of tin remaining free on the grain boundaries. It was found that the bulk of the tin was free. Scanlon and Lark-Horovitz have measured the resistivitis of these samples at temperatures of 295°K and 88°K.

They found that, as the temperature decreases, the resistivities of the various samples decrease, following curves closely parallel to the resistivity curve of pure tin. This behavior is explained by assuming that most of the added tin collects along the grain boundaries as free tin and conducts current in parallel with the germanium portion of the sample. The percentage of free tin may be computed from the resistivity samples. The calculated values are found to be in fairly good agreement with the percentages found by x-ray methods.

Photonegative Effects in Germanium Crystals. S. BENZER, Purdue University.—The resistance of a metal-to-germanium point contact is in many cases quite sensitive to illumination, the effect of light usually being an instantaneous increase in current. In some cases, however, as the illumination is maintained, the current actually decreases to a value which may be as low as half the original dark current. When the illumination is removed, the current drops still further and then gradually increases back to the original dark value. The time constants involved in these effects are of the order of minutes, compared with less than 10^{-5} second for the instantaneous photoeffects. Photonegative effects have also been observed in materials other than germanium and are of interest in connection with the theory of the rectifying contact.

Determination of the dielectric constant of Tellurium. V. A. JOHNSON, Purdue University.—Scanlon and Lark-Horovitz have recently investigated the electrical properties of tellurium. In order to compare their results with semi-conductor theory, it is necesary to know the dielectric constant of tellurium. The value is estimated from optical constants by two different methods. The first method, developed by Herzfeld and Mullaney, uses the classical dispersion formula to express the dielectric constant in terms of the index of refraction and coefficient of extinction. Since tellurium is non-isotopic, there are two sets of such data depending upon whether the single crystal axis is parallel or perpendicular to the plane of incidence. For these cases, the dielectric constant is found as $5.0 \pm .5$ and $2.2 \pm .5$, respectively. Since the tellurium samples used in electrical measurements are composed of many randomly oriented single crystals, the dielectric constant may be taken as an average, $3.6 \pm .5$. The second method uses reflectivity data for various wave lengths in the infra-red and is based upon the electromagnetic theory of light in a conducting medium. This method yields a dielectric constant of 3.9. The agreement between values obtained by the two methods is satisfactory.

The isomeric pair In^{112}. H. L. BRADT and D. J. TENDAM, Purdue University.—The 23 minute period of In^{112} is followed by negative and positive electrons, In- and Cd- X-rays, and the conversion electrons of a highly converted 0.16 Mev gamma-ray. Since a large fraction of the X-rays are In-X-rays, the observed conversion electrons must be emitted in an isomeric transition in In^{112}, the period of the upper level being 23 minutes. Decay curves of In^{112}, produced by Ag (α, n) and In $(n, 2n)$ and In (γ, n) reactions show that the negative and positive electron activity follows the 23 minute period only after a certain time. This growth curve,

first observed by R. N. Smith in this laboratory, shows that a 9 minute activity grows from the 23 minute activity; the effect is greatest in the decay of In^{112} produced by (γ, n) and $(n, 2n)$ reactions with In^{113}, smaller in that produced by the Ag^{109} (α, n) reaction, and not noticeable in In^{112} from the Cd^{111} (d, n) reaction. The excitation energy and the lifetime of the metastable level place the In^{112} isomeric transition in the $l=4$ group. Measured values of the conversion probability and the absolute intensity of the In-K-X-rays are in good agreement with the values calculated for electric 24-pole radiation.

The relative yields of the $(\alpha, 2n)$ and (α, n) reactions for bombardment of Rh^{103} with 15-20 mev alpha-particles. D. J. TENDAM and H. L. BRADT, Purdue University.—In order to test the statistical theory of nuclear reactions of V. F. Weisskopf, the relative probability of emission of one to two neutrons from the compound nucleus, which is formed by the bombardment of Rh^{103} with alpha-particles, was measured as a function of the energy of the bombarding particle. Emission of one neutron from the compound nucleus, that is, the Rh^{103} (α, n) Ag^{106} reaction, leads to the well known silver isotope Ag^{106} either in its ground state, which decays with a half-life of 25 minutes by $\beta\pm$ emission, or in its isomeric metastable state, which decays by K-capture with a half-life of 8.2 days. Emission of two neutrons, that is, the Rh^{103} $(\alpha, 2n)$ Ag^{105} reaction, leads to the silver isotope Ag^{105}, to which heretofor a period of 45 days has been assigned only tentatively. From its excitation curve it is clear that the 45 day period is the product of an $(\alpha, 2n)$ reaction and hence can be assigned definitely to Ag^{105}. The threshold for the Rh^{103} $(\alpha, 2n)$ Ag^{105} reaction is 16 ± 0.5 Mev. The curve for the yield ratio of the competing $(\alpha, 2n)$ and (α, n) reactions are in agreement with the results of the statistical theory of nuclear reactions.

A detailed study of the beta-ray spectra of Cu^{64}. C. SHARP COOK and LAWRENCE M. LANGER, Indiana University.—A large precision semi circular type nuclear spectrometer has been constructed. This instrument is different from most semi circular type spectrometers in that it employs an inhomogenous magnetic field which produces higher order focusing in a plane. This gives the instrument much higher resolution than has been obtainable in the past. Because of its large size (radius of curvature is 40 cm.) the instrument is completely free from scattering. Both the negatron and positron spectra of Cu^{64} have been studied under optimum conditions. These measurements indicate considerable deviation from the Fermi theory of beta decay at low energies.

Radiations of Sc^{46}, Au^{198}, and W^{187}. CHARLES L. PEACOCK, Indiana University.—The decays of Sc^{46}, Au^{198}, and W^{187} have been studied in a small 180° type of beta ray spectrometer in which use was made of the fringing field to increase resolution. The Sc^{46} has been found to emit two groups of beta rays of maximum energies .36 and 1.49 Mev and two gamma rays of .88 and 1.12 Mev. The Au^{197} emits a beta ray of .97 Mev and a gamma of .41 Mev. The W^{187} emits two beta rays of .63 and 1.33 Mev and two gammas of .69 and .49 Mev.