Fig. 2. Palladium ingot—top view

because the melt does not wet its container. When aluminium oxide is used as the container in growing palladium crystals, the diameter of the single crystal ingot should exceed the diameter of the crystal desired because of the gas bubbles, which collect at the crystal-container interface.

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CHEMISTRY

A Photoionization Detector for Gases and Vapours

SENSITIVE ionization methods for the measurement of low gas and vapour concentration require the ionization of the test gas or vapour under conditions where an inert carrier gas is unionized. Such methods as the ionization of carbon compounds in a hydrogen flame¹ and the reaction between gases and vapours and rare gas metastables² are well established and successful for this purpose. An alternative method is to irradiate the gas mixture with ultra-violet radiation of such a frequency that photoionization of the test gas occurs without any accompanying ionization of an inert carrier gas. In practice an electrical discharge in one of the rare gases or in nitrogen or hydrogen generates photons of energy sufficient for the ionization of almost all polyatomic compounds, but with insufficient energy to ionize simple diatomic gases.

A practical photoionization detector is illustrated in Fig. 1, together with the details of its construction. The gas supply to the discharge which generates the ultra-violet radiation is led through the tube (A);

this tube also serves as a cathode for the discharge, and in use a current of a few m. amp. is maintained between this cathode and the anode (B). The test gas is introduced through the tube (D); this also serves as the collecting electrode for the ions liberated within the chamber enclosed by the second cathode (C). When the discharge is supplied with hydrogen, nitrogen or argon it is necessary to reduce the pressure within the detector to 100 mm. or less; at higher pressures a stable discharge is difficult to maintain. With helium however a stable discharge is possible at atmospheric pressure particularly if the detector is supplied with radiofrequency energy instead of d.c.³ The carrier gas in which the test sample is introduced into the sensing chamber (C) can be almost any gas which is not itself ionized by the radiation from the discharge. Water-saturated air, for example, gives entirely satisfactory results.

Fig. 1. Construction of the detector. A, Inlet for discharge gas and cathode connexion; B, discharge anode; C, measuring chamber anode; D, sample inlet and cathode; E, outlet to water pump. The detector body is of glass, the cathodes of platinum tubing and the anodes are of copper

The detector illustrated gave a current of approximately 10^{-10} amp. in the absence of ionizable vapour, possibly due to the photoelectric emission of electrons from the surfaces of the measuring chamber (C). In the presence of ionizable vapour, a substantially linear response to vapour concentration was observed up to a signal current of 10^{-7} amp. The efficiency of ionization of propane as a test substance was approximately 0.01 per cent. The response of the detector appeared to be unaffected by gross contamination of its surfaces with dirt or decomposition products and was stable over long periods and on repeated operation. The stability of this device, unlike that of other discharge methods of measuring vapour concentration, is probably due to the fact that the discharge takes place within the hollow cathode (A), which contains only a clean and uncontaminated supply of inert gas. The design shown should not be considered as final, but rather to illustrate the potentialities of this method.

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