

produce the surface film as determined by Will and Knorr² is shown by the dotted lines in Fig. 1, and it is apparent that there is a very good correlation between this quantity and the percentage of light absorbed. Both types of curve show a similar hysteresis effect between values obtained with increasing and decreasing potential. These preliminary experiments suggest a maximum light adsorption for chemisorbed oxygen on platinum at 3500 Å corresponding to a heat of adsorption of about 80 kcal. mole⁻¹.

Will and Knorr also observed hydrogen adsorption when the potential was decreased from 0.3 to 0.0 V, and in this region we detected an increase in light absorption, but the results were less reproducible. Hydrogen evolution is very sensitive to trace impurities and a higher degree of purity may be necessary for reproducible results at these potentials.

Large changes in the percentage light absorbed with change in potential have also been observed for the oxygen adsorption on gold in 0.5 M sulphuric acid, and also during the anodic dissolution of gold in aqueous cyanide solution. The latter results indicate that adsorbed species can be determined by this method while appreciable currents are flowing.

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¹ Slygin, A., and Frumkin, A., *Acta physicochim. U.R.S.S.*, **3**, 791 (1935).

² Will, F. G., and Knorr, C. A., *Z. Elektrochem.*, **64**, 258 (1960).

³ Conway, B. E., Gileadi, E., and Dzieluch, M., *Electrochim. Acta*, **8**, 143 (1963).

New Elements as Potential Refractories

EXAMINATION of a Lothar-Meyer plot with reference to the synthesis of elements up to 102, and the possibility of producing even higher elements, lead to some rather interesting speculations. On observation of the Lothar-Meyer plot of melting points (Fig. 1) several different types of characteristic periodic variations become apparent. Within Groups IA (lithium to caesium), IB (zinc to mercury), IIA (beryllium to barium), IIIA (boron to thallium), IVA (carbon to lead) and IVB (titanium to hafnium) the melting points tend to decrease with increasing atomic number. Within groups VB (vanadium to tantalum), VIA (oxygen to polonium), VIB (chromium to tungsten), VIIA (fluorine to astatine), VIIB (manganese to rhenium), VIIIA (helium to radon) and VIIIB (iron to osmium) the melting points tend to increase with increasing atomic number. Groups IIIB (scandium to lanthanum), VA (nitrogen to bismuth) and VIIB (cobalt to iridium and nickel to platinum) exhibit an intermediate behaviour in which the melting points first increase and then decrease with increasing atomic number; and group IB (copper to gold) exhibits a slight minimum.

The second type, in which the melting point increases, is of interest here, with major emphasis on groups VIB and VIIIB. Thus, if one may be permitted a small extrapolation, which, in view of Mendeleev's signal success, may not be too inconceivable or impertinent, it may be predicted that eka-tungsten and eka-rhenium will be even more refractory than tungsten or rhenium. The assignment of elements 90-103 to the actinide series by Seaborg¹ allows one to predict, by analogy, that elements 106 and 107 will be eka-tungsten and eka-rhenium, respectively. (If the elements 90-103 are not assigned to an inner

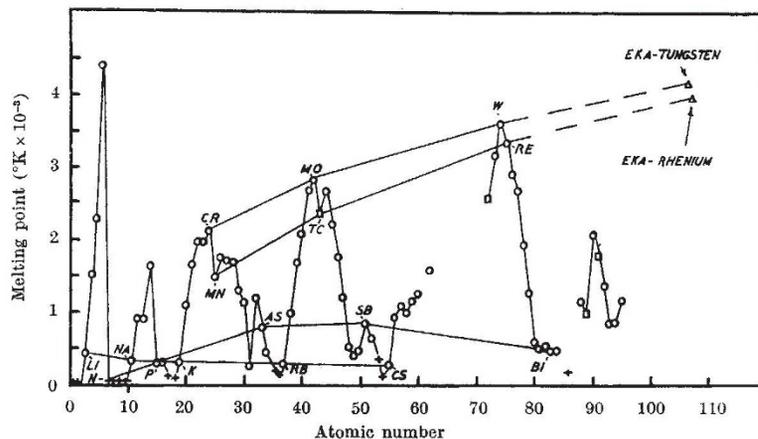


Fig. 1. Melting points of the elements. ○, From Glassner, A., *Thermochemical Properties of Oxides, Fluorides, and Chlorides, to 2,500° K*, Argonne Nat. Lab. Rep. 5750, Table 1 (1954). □ From Glassner, estimated values. + From Hodgman, C. D. (edit.), *Handbook of Chemistry and Physics* (Chemical Rubber Co., 1954)

transition series, then eka-tungsten would be uranium, and its melting point should be much higher. Its comparatively low melting point may even be cited as evidence to support the Seaborg assignments.) Extrapolation of the melting points in Fig. 1 then indicates a melting point of about 4,200° K for elements 106 and 107. Due to the diminutive half-lives predicted for elements above 102, the practical value of these observations is not immediately apparent. However, because of the intriguing theoretical implications, and the present interest in high-temperature refractories for rocket, fission and fusion applications, they are being presented here. As refractories these elements might be useful as nuclear fuel elements which could be operated for extended periods at temperatures well in excess of those possible with present materials.

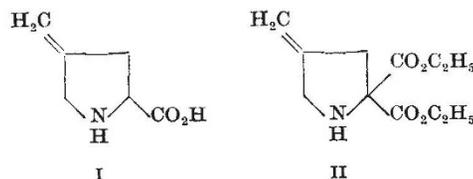
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¹ Friedlander, G., and Kennedy, J. W., *Introduction to Radiochemistry*, 274 (John Wiley and Sons, Inc., New York, 1949).

Synthesis of 4-Methylene-DL-proline: a Naturally Occurring Racemic Amino-acid

ROTATIONAL and other data from the synthesis of an optically active derivative¹ have shown that 4-methylene-proline (I) isolated under non-epimerizing conditions from loquat seeds² is racemic. The suspected biogenetic precursor, γ -methyleneglutamic acid, on the other hand, has been found only in optically active form³, although in different plant sources⁴. In view of the rare occurrence of racemic amino-acids in Nature we wish to record the following simple synthesis of 4-methylene-DL-proline, along with direct comparison evidence confirming its identity with the natural compound.



Alkylation of diethyl aminomalonate (used as the hydrochloride (Aldrich Chemical Co., Inc., Milwaukee, Wisconsin)) with 1,3-dichloro-2-methylenepropane⁵ in ethanol at 55° in the presence of sodium ethoxide (three equivalents) afforded, in 60 per cent yield, the methylene-