

of hydrogen, is necessary. This correction is at present under investigation.

The study of the variation of the potential of the cell with pressure is being extended to higher pressures.

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[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF Breslau]

NITROSYL SELENIC ACID

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Received February 27, 1922

Since selenic acid, in many respects, is similar to sulfuric acid, it is to be expected that it would give with nitrous acid an anhydrous compound corresponding to nitrosyl sulfuric acid, $\text{SO}_2(\text{OH})(\text{ONO})$. Victor Lenher and J. H. Mathews,¹ by treating selenic acid of the strength of about 83% with liquid nitrogen tetroxide (N_2O_4) at a temperature obtained by the use of solid carbon dioxide, have prepared dinitrosyl selenic acid $\text{SeO}_2(\text{ONO})_2$ which is stable below -13° and which is described as an easily decomposable compound of blue color. Previous to our experiments, the mononitrosyl compound had not been described.

The existence of a new compound between selenic and nitrous acid can be shown by dissolving solid sodium nitrite in ice-cold selenic acid of about 95% strength. The salt dissolves without evolution of gas and without change in color of the liquid. On diluting the solution with water, red oxides of nitrogen are evolved in large amounts, a behavior resembling the decomposition of "lead chamber crystals" by water.

In order to prepare nitrosyl selenic acid we brought together, in absence of water, liquid nitrogen trioxide (N_2O_3) and selenic acid prepared by the method of Meyer and Moldenhauer.² While sulfur dioxide reacts readily with nitric acid to form nitrosyl sulfuric acid, selenium dioxide in our experience does not react similarly.

In order to prepare nitrosyl selenic acid, liquid nitrogen trioxide is poured into 100% selenic acid, the former being in great excess. The greater part of the excess of the nitrogen trioxide is evaporated from the white crystalline mass by vigorous stirring, after which the last trace of excess of the oxides of nitrogen is removed by spreading the crystals on a porous plate and evaporating, at as low a temperature as possible, in a vacuum desiccator. The white crystals can be preserved in dry, sealed tubes, but decompose when warmed, with an evolution of the red oxides of nitrogen. Moisture decomposes the crystals with a similar evolution and the solution when treated with barium chloride yields barium selenate. The crystals irritate the skin.

¹ Lenher and Mathews, *THIS JOURNAL*, **28**, 516 (1906).

² Meyer and Moldenhauer, *Z. anorg. Chem.*, **116**, 193 (1921).

Analysis.—Weighed quantities of the crystals were decomposed with water in a Meyer-Janek apparatus.³ The free selenic acid was reduced to selenious acid by heating with conc. hydrochloric acid, after which it was reduced to elementary selenium by hydrazine. Two analyses yielded 45.0 and 44.5% of selenium, while $\text{SeO}_2(\text{OH})(\text{ONO})$ requires 45.3% of selenium.

For the determination of nitrogen, weighed quantities of the crystals were shaken in a closed bottle with a solution of sodium hydroxide until the nitrogen oxide fumes which were evolved had again been absorbed. The resulting solution was treated with a measured excess of potassium permanganate solution, and after oxidation of the nitrous to the nitric acid, the excess of permanganate was titrated back by means of oxalic acid. In two samples, 7.3 and 7.4% of nitrogen were found. Nitrosyl selenic acid requires 8% of nitrogen. Considering the methods of analysis used, the results are sufficiently accurate.

Nitrosyl selenic acid, $\text{SeO}_2(\text{OH})(\text{ONO})$, is decomposed by water. It is readily soluble in conc. selenic and conc. sulfuric acids. Nitrosyl sulfuric acid is also soluble in these acids, and both compounds are soluble in absolute alcohol but not in ether. At 80°, nitrosyl selenic acid melts with decomposition. This is also the melting point of nitrosyl sulfuric acid and is considerably higher than that of pure selenic acid, which is 58°.

Nitrosyl selenic acid is very reactive and with certain of the organic amines readily forms compounds, which we are studying.

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[CONTRIBUTION FROM THE KENT CHEMICAL LABORATORY OF THE UNIVERSITY OF CHICAGO]

THE SEPARATION OF ISOTOPES BY THERMAL AND PRESSURE DIFFUSION

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Received March 1, 1922

Introduction

With the ultimate aim of obtaining extensive separations of isotopes, a careful preliminary study, both theoretical and experimental, is being made, in order to find the best practical method or methods. In a previous paper by Mulliken and Harkins² the theory was developed and equations obtained for the change of composition and atomic weight for the fractions obtained when a mixture of isotopes is subjected to a process of irreversible evaporation, molecular effusion, molecular diffusion, or gaseous diffusion. A rather complete summary of the possible methods for separating isotopes was also given (p. 62). In the present paper, the theory of the method of thermal diffusion and that of the centrifugal

³ Meyer and Janek, *ibid.*, **83**, 51 (1913).

¹ National Research Fellow in Physical Chemistry.

² Mulliken and Harkins, *THIS JOURNAL*, **44**, 37 (1922).