
ENCYCLO-
PEDIA
of
CHEMICAL
REACTIONS



JACOBSON

VOLUME VI

Sm, Sc, Se, Si,
Ag, Na

0-11-58
7-11-58
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ENCYCLOPEDIA OF CHEMICAL REACTIONS

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VOLUME VI

SAMARIUM

SILICON

SCANDIUM

SILVER

SELENIUM

SODIUM

**REINHOLD PUBLISHING CORPORATION
NEW YORK**

CHAPMAN & HALL, LTD., LONDON

1956

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Library of Congress Catalog Card No. 46-822

REINHOLD PUBLISHING CORPORATION

*Publishers of Chemical Engineering Catalog, Chemical
Materials Catalog, "Automatic Control," "Materials &
Methods," "Progressive Architecture"; Advertising
Management of the American Chemical Society*

Set and Printed in U.S.A.

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Preface

The entries in this and succeeding volumes of the "Encyclopedia of Chemical Reactions" represent almost entirely the file compiled by the late Dr. C. A. Jacobson at the time of his death several years ago. They are based upon reactions abstracted from technical and scientific periodicals by over 100 abstractors who endeavored to fulfill his goal of a compilation of chemical reactions involving inorganic reagents.

While the coverage admittedly is incomplete, due to the patent impossibility of culling completely the vast stock of chemical periodical literature, the publication of the remaining volumes of the series is being carried on in the belief that the reactions presented therein offer a valuable reference source to chemists in a wide variety of fields. The Editor has examined and edited all the entry cards in Dr. Jacobson's file, as well as the few hundred received since he undertook to complete the series, with the idea of eliminating duplicates, achieving consistency in nomenclature and formulation, and minimizing the inclusion of erroneous or untenable reactions and descriptions. While criticism may be made of some of his decisions relating to content and to mode of presentation, it is hoped and intended that the material included is helpful rather than confusing to the users of the book.

The indexes were prepared by Elbert C. Weaver, Department of Chemistry, Phillips Andover Academy, Andover, Mass., and deep appreciation is acknowledged for his conscientious work in this activity, as well as for his careful and helpful proofreading of the initial and final proofs of the book. Without his valuable assistance the work of the Editor would have been much less effective. Sincere thanks are also given to the associate editors and the abstractors for their contributions that made the whole work possible.

Clifford A. Hampel

Skokie, Ill.

September, 1956

Abbreviations

Ac stands for	acetate
\bar{c} stands for	with
conc. stands for	concentrated
Δ stands for	heat
decomp. stands for	decomposition
dil. stands for	dilute
ϵ stands for	electric current or spark
Et stands for	ethyl
m- stands for	meta
M stands for	univalent metal
Me stands for	methyl
N stands for	normal
o- stands for	ortho
p- stands for	para
P stands for	pressure
Ph stands for	phenyl
p.p.m. stands for	parts per million
sol. stands for	solution
en stands for	ethylenediamino
pn stands for	propylenediamino
py stands for	pyridino

Temperatures are in degrees centigrade unless otherwise indicated.

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SAMARIUM



VI - 1

Solutions of samarium bromide and gold bromide mixed and evaporated yield large, deliquescent, rhombic tablets of decahydrated samarium bromoaurate.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 16 (1885)

10



VI - 2

Samarium bromide crystallizes from a water solution as large, topaz-yellow, deliquescent, hexahydrated crystals.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 16 (1885)

10



VI - 3

Solutions of samarium cyanide and platinum cyanide mixed and evaporated yield the hydrated double cyanide of samarium and platinum.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 16 (1885)

10



VI - 4

Solutions of samarium acetate and tartaric acid precipitate hexahydrated samarium tartrate as a copious white powder.



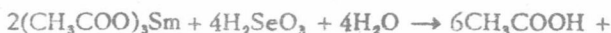
P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 20 (1885)

10



VI - 5

Selenous acid added to samarium acetate solution precipitates pentahydrated samarium selenite selenous anhydride, as a voluminous powder which quickly changes to microscopic needles.



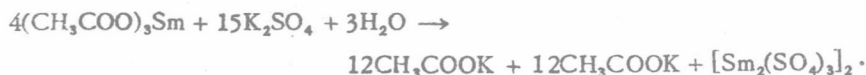
P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 40, No. 7, 24 (1883)

10

K₂SO₄

VI-6

An excess of potassium sulfate precipitates, from a samarium acetate solution, white, powdery 2:9:3 hydrated double sulfate of samarium and potassium.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **40**, No. 7, 24 (1883)

10

**AuCl₃**

VI-7

Solutions of samarium chloride and gold chloride mixed and evaporated yield large, deliquescent, rhombic tablets of decahydrated samarium chloroaurate.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 16 (1885)

10

**HF**

VI-8

From samarium salt solution, hydrofluoric acid precipitates hemihydrated samarium fluoride as a whitish, voluminous powder.



P. T. Cleve, Nova Act. Reg. Soc. Sci. Upsal., [3], **13**, No. 2, 8 (1885)

10

**HIO₃**

VI-9

Solutions of samarium salts and iodic acid precipitate hexahydrated samarium iodate as a white, amorphous powder.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 16 (1885)

10

**H₂**

VI-10

Samarium trichloride heated in a current of dry hydrogen is reduced to samarium dichloride with hydrogen chloride being formed.



C. Matignon, Ann. chim. phys., [8], **8**, 420 (1906)

100

H₂C₂O₄**SmCl₃****VI-11**

Samarium oxalate is precipitated from samarium chloride solution by oxalic acid. This is a type reaction; cerium and lanthanum do the same.

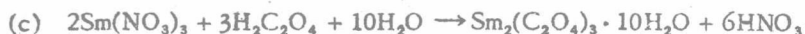


W. Crookes, Trans. Roy. Soc. (London), **176**, 695 (1885)

105

H₂C₂O₄**SmCl₃****VI-12**

Warm concentrated solutions of oxalic acid and of samarium salts precipitate decahydrated samarium oxalate as white flocculent powder that changes first to a light-yellow, tough mass and then to a white, hard mass.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **40**, No. 7, 25 (1883)

10

H₂S**SmCl₃****VI-13**

Anhydrous samarium trichloride heated in a current of hydrogen sulfide gas decomposes a little at a time to form brown samarium sulfide and hydrogen chloride.



C. Matignon, Ann. chim. phys., [8], **8**, 414 (1906)

100

KHCO₃**SmCl₃****VI-14**

An excess of potassium bicarbonate added to a samarium salt solution precipitates hexahydrated samarium potassium carbonate as a voluminous, amorphous powder which quickly changes to lustrous scales.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 17 (1885)

10

K₂C₂O₄**SmCl₃**

VI-15

Solutions of samarium salts and potassium oxalate precipitate white, amorphous samarium potassium oxalate, possibly hydrated.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 19 (1885)

10

K₄Fe(CN)₆**SmCl₃**

VI-16

Samarium salts and potassium ferrocyanide solutions precipitate amorphous, dirty yellow, finely crystalline samarium potassium ferrocyanide, perhaps hydrated.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 16 (1885)

10

NH₄OH**SmCl₃**

VI-17

Ammonium hydroxide, added to a samarium salt solution, precipitates gelatinous, yellowish white samarium hydroxide.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 40, No. 7, 22 (1883)

10

Ref., W. Crookes, Trans. Roy. Soc. (London), 176, 696 (1885)

105

NaOH**SmCl₃**

VI-18

The rapidly precipitated and unaged oxide of samarium is a hydrous form.



A. B. Weiser and W. O. Milligan, J. Phys. Chem., 42, 677 (1938)

85



VI-19

Mixed solutions of samarium chloride and platinum tetrachloride yield on evaporation long, deliquescent, orange-colored prisms of the hydrated double chloride of samarium and platinum.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **40**, No. 7, 22 (1883)

10



E

VI-20

Anhydrous samarium chloride is mixed with one-third its weight of barium chloride, fused and electrolyzed in an apparatus using carbon electrodes and a current of 100 amperes. Metallic samarium is produced as a gray powder which becomes yellowish in the air.



W. Muthman and L. Weiss, Ann., **331**, 24 (1904)

20



A

VI-21

Samarium trichloride hexahydrate heated to 110° in presence of anhydrous hydrogen chloride gas loses 5 molecules of water, forming the monohydrate. Prolonged heating at 180° causes loss of the last molecule of water of hydration to form anhydrous samarium trichloride.



C. Matignon, Ann. chim. phys., [8], **8**, 373 (1906)

100



VI-22

3.5 grams of samarium nitrate are dissolved in 20 ml of water and treated with 4.5 grams of freshly distilled acetylacetone made slightly alkaline with ammonia. Crystals of samarium acetylacetonate crystallize from the solution. These are dried over sulfuric acid. They melt at 146.7° .



W. Biltz, Ann., **331**, 344 (1904)

20


 HIO_4

VI-23

From a samarium nitrate (or samarium acetate) solution, periodic acid precipitates tetrahydrated samarium periodate as an amorphous powder which quickly changes to small prismatic needles.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 16 (1885)

10


 H_2SO_4

VI-24

Samarium nitrate and sulfuric acid, evaporated on the water bath, yield large, well-formed, lustrous, topaz-yellow crystals of octahydrated samarium sulfate.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **40**, No. 7, 23 (1883)

10


 K_2CrO_4

VI-25

Solutions of samarium nitrate and potassium chromate precipitate trihydrated samarium potassium chromate as a yellow crystalline powder.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 19 (1885)

10


 NH_4OH
 $\text{C}_3\text{H}_4\text{O}_4$

VI-26

5.43 grams of samarium nitrate are dissolved in water and treated with ammonium hydroxide. The suspended samarium hydroxide is then treated with the calculated amount of malonic acid in water. The solution is filtered and the filtrate heated to boiling for thirty minutes. Crystals of samarium malonate with six H_2O form.



H. Erdmann and F. Wirth, Ann., **361**, 203 (1908)

20



VI-27

An excess of ammonium carbonate precipitates from a samarium nitrate solution dihydrated samarium ammonium carbonate as a heavy yellowish-white powder made up of microscopic crystalline pellets.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 17 (1885)

10



VI-28

When solutions of samarium nitrate and sodium metavanadate are mixed, anhydrous samarium orthovanadate precipitates as a yellowish-white amorphous powder.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 18 (1885)

10



VI-29

A large excess of sodium carbonate solution precipitates from a samarium nitrate solution octahydrated samarium sodium carbonate as a heavy, yellowish-white, crystalline powder.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 17 (1885)

10



VI-30

Solutions of samarium nitrate and disodium orthophosphate precipitate dihydrated samarium orthophosphate as a white, amorphous powder.



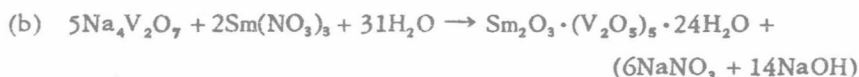
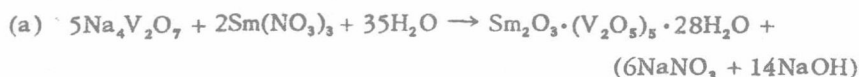
P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., 42, No. 1, 18 (1885)

10



VI-31

Solutions of samarium nitrate and of sodium pyrovanadate, when mixed, yield on evaporation large, well-formed red and yellow crystals of the 1:5:28 and 1:5:24, respectively, hydrated samarium metavanadate vanadic acid anhydride.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 18 (1885)

10



VI-32

Carbon dioxide changes samarium hydroxide suspended in water to a yellowish-white crystalline powder, trihydrated samarium carbonate.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 17 (1885)

10



VI-33

Yellow transparent crystals of samarium ethylenedisulfonate are formed when ethylenedisulfonic acid is saturated with samarium hydroxide.



James, Hoben and Robinson, J. Am. Chem. Soc., **34**, 279 (1912)

1



VI-34

Samarium hydroxide dissolves in pyrophosphoric acid and soon deposits small clusters of crystals of heptahydrated samarium hydrogen pyrophosphate.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 18 (1885)

10


 H_2O

VI-35

Samarium thiocyanate crystallizes from water solution as deliquescent, light yellow needles of the hexahydrated salt.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 16 (1885)

10


 $\text{Hg}(\text{CN})_2$

VI-36

Solutions of samarium thiocyanate and mercuric cyanide yield on evaporation needle crystals of the dodecahydrated double salt, samarium thiocyanate trimercuric cyanide.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 16 (1885)

10


 Δ

VI-37

Samarium oxalate when heated yields samarium sesquioxide as a white powder with a tinge of yellow.



P. T. Cleve, K. Sven. Vet. Ak. Handl. Öfvers., **40**, No. 7, 19 (1883)

10


 Δ

VI-38

 HCl
 H_2SO_4

Samarium oxalate is converted into the oxide when ignited and this product is treated with hydrochloric acid, forming samarium chloride. When the chloride is dissolved in alcohol and treated with sulfuric acid, the sulfate precipitates.



Simon Freed, J. Am. Chem. Soc., **52**, 2704 (1930)

1

Sm_2O_3

$\text{CH}(\text{SO}_3\text{H})_3$ **VI-39**

Samarium methanetrissulfonate separates when a slightly acid solution of samarium oxide in methanetrissulfonic acid is evaporated.



James, Hoben and Robinson, J. Am. Chem. Soc., **34**, 278 (1912) 1

Sm_2O_3

$\text{CH}_3\text{SO}_3\text{H}$ **VI-40**

Samarium methylsulfonate is produced when samarium oxide is added to methylsulfonic acid, heated nearly to boiling.



James, Hoben and Robinson, J. Am. Chem. Soc., **34**, 277 (1912) 1

Sm_2O_3

$\text{C}_2\text{H}_5\text{SO}_3\text{H}$ **VI-41**

Samarium ethylsulfonate is formed when samarium oxide is added to ethylsulfonic acid, heated nearly to boiling.



James, Hoben and Robinson, J. Am. Chem. Soc., **34**, 276 (1912) 1

Sm_2O_3

$\text{C}_6\text{H}_4(\text{NO}_2)\text{SO}_3\text{H}$ **VI-42**

Samarium oxide is dissolved in metanitrobenzene sulfonic acid. Large crystals of samarium metanitrobenzene sulfonate are obtained from this solution.



O. Holmberg, Z. anorg. Chem., **53**, 83 (1907) 28

Sm_2O_3

Cl_2 **VI-43**

Chlorine gas passed over hot samarium oxide yields white powdered samarium oxychloride.



P. T. Cleve, E. Sven. Vet. Ak. Handl. Öfvers., **42**, No. 1, 15 (1885) 10
