

Chromium(IV) Oxide Prepared from Chromium(III) Nitrate Nonahydrate

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Six supplies of chromium(III) nitrate nonahydrate each weighing 80.0300 g (0.20 mol) were heated in suitable size beakers under an open hood and over a bunsen burner flame until all the nitrogen dioxide gas had evolved. Black solids weighing 16.7642 g were produced (99.787% based on chromium(III) nitrate nonahydrate) and they were ferromagnetic [1]. They also were insoluble in water and in the mineral acids at any temperature.

A sample of the combined products was subjected to X-ray analysis with copper radiation but neither any pictures nor any data could be obtained.

The color, the solubility tests, the yield and the magnet test were evidences that the thermal decomposition of chromium(III) nitrate nonahydrate was similar to that for cobalt(II) nitrate [2]. The X-ray analysis also was evidence and it was shown from this that the product was amorphous [3] otherwise pictures and data would have been obtained. Since the thermal decompositions of cobalt(II) nitrate and chromium(III) nitrate nonahydrate are similar, the equation for the preparation of chromium(IV) oxide is $2[\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}] \rightarrow 18\text{H}_2\text{O}\uparrow + 2\text{CrO}_2 + 6\text{NO}_2\uparrow$

+ $\text{O}_2\uparrow$. The oxidation of the metals accounts for the similarity in the process otherwise the decomposition would have been similar to that for copper(II) nitrate [2] and lead(II) nitrate [2] in which the metals are neither oxidized nor reduced and chromium(III) oxide would have been formed. Cobalt is oxidized from plus two to plus three but chromium is oxidized from plus three to plus four.

Chromium(IV) oxide, known also as chromyl chromate [4], also is prepared by the hydrothermal reduction of chromium(VI) oxide [5].

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References

- 1 Anders and Sonnessa, *Principles of Chemistry, An Introduction to Theoretical Concepts*, MacMillan, New York, N.Y., 1965, p. 91.
- 2 Nebergall, Holtzclaw and Robinson, *General Chemistry* Sixth Edition, D.C. Heath and Company, Lexington, Mass., 1980, pp. 963, 886 and 926.
- 3 Don Roach and Edmund Laddy Jr., *Basic College Chemistry*, McGraw-Hill Book Company, New York, N.Y., 1979, p. 592.
- 4 J. W. Mellor, *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*, Volume XI, Longmans, Green and Co., London-New York-Toronto, 1931, pp. 208-209.
- 5 Cotton and Wilkerson, *Advanced Inorganic Chemistry, A Comprehensive Text*, Third Edition, John Wiley and Sons Inc., New York, N.Y., 1972, p. 833.