2.12.5: Lecture Demonstrations

Formula of an Iron Oxide: combustion of pyrophoric iron or steel wool

It is difficult to do a quantitative determination of a formula as a lecture demonstration. This demonstration is at best semi-quantitative, but it's interesting and suggests methods that might be more quantitative, and points to variables that must be controlled in a quantitative experiment.

A. Steel Wool: Weigh ~0.5 g of 000 or 0000 steel wool in an evaporating dish. With tongs, dip it in petroleum ether or hexane to remove surface oil which is present to prevent oxidation. Shake off most of the hexane, then hold the steel wool over the evaporating dish and ignite it with a Bunsen burner. Catch the product in the evaporating dish and reweigh. Calculate the formula from data, or from "optimal" data supplied by calculation. Discuss: (1) The product may be a mixture of FeO, Fe_2O_3, and Fe_3O_4. (2) some of the product may not have been collected. (3) the steel wool isn't really pure Fe.

B. Pyrophoric Iron: Prepare ~0.5 g of pyrophoric iron by decomposition of FeC_2O_4 under methane [1] in a weighed 15 x 150 mm test tube with a two holed rubber stopper to allow inlet of methane product gases. Insert a long pipette in one hole, and ignite the product gases after allowing time for methane to fill the apparatus. Heat the iron oxalate gently so that it turns completly black, but avoid further heating. Weigh the tube plus product. Weigh an evaporating dish, and pour the product into it, then reweigh. Reweigh the empty tube. From the masses of the iron and product, calculate it's formula.

Notes:

1. It's more fun to dump the product through several feet of air and watch the combustion reaction, but product will be lost. This may be inconsequential, because the calculations may be done with "optimal" data, noting the difficulties of making the demonstration as presented quantitative.

2. The product of the reaction is almost certainly not pure. It probably contains several oxides, as well as sintered (nonpyrophoric) iron that results from overheating the product.

References

1. J. Chem. Educ., 1931, 8 (2), p 303