SOLID STATE REACTIONS
IN THE POTASSIUM IODATE
AND MOLYBDENUM(VI) OXIDE SYSTEM

K. Suba and M. R. Udupa

DEPARTMENT OF CHEMISTRY, INDIAN INSTITUTE OF TECHNOLOGY,
MADRAS–600 036, INDIA

The reaction between potassium iodate and molybdenum(VI) oxide in mixtures of different mole ratios has been investigated employing TG and DTA techniques in static air atmosphere. The products are characterised by infrared spectroscopy, chemical analysis and X-ray diffraction studies. The studies indicate the formation of mono-, di-, tri- and tetramolybdates of potassium from mixtures with 2:1, 1:1, 2:3 and 1:2 mole ratios of KIO₃:MoO₃. The kinetics of the reaction was followed and the energy of activation values were computed.

An interesting aspect of the decomposition of halogenoxyacids and their salts is that they are extremely sensitive to the presence of additives. Detailed studies have been made on the influence of transition metal oxides during the thermal decomposition of various halates like KClO₄ [1, 2], KClO₃ [4], TlClO₄ [3], NaClO₂ [5], Ba(ClO₄)₂ [6] etc. In presence of Cr(III) oxide for instance, these salts decompose at strikingly low temperatures and further, oxidise the Cr(III) to Cr(VI) compounds. Thus a study of the interaction of MoO₃ with KIO₃ appeared relevant and the results of the study using TG and DTA techniques are reported in this paper. The products are characterised by infrared spectroscopy, chemical analysis and X-ray powder diffraction studies. The kinetics of the reaction was followed by the Coats–Redfern [7] method and the activation energy values have been calculated.

Experimental

Analytically pure grade KIO₃ was used as such. Molybdenum(VI) oxide was obtained by heating reagent grade H₂MoO₄·H₂O at 400° until the dehydration was complete. The MoO₃ so obtained was stable upto 790° after which it started subliming.

Reaction mixtures were prepared by grinding together KIO₃ and MoO₃ in mole ratios of 1:3, 1:2, 2:3, 1:1, 2:1 and 3:1 in an agate mortar for 10–15 min.
Thermogravimetry and differential thermal analysis were done in air using a Stanton simultaneous thermal analyser 783 instrument at a linear heating rate of 10 deg/min. Constant temperature heating experiments were carried out in air using a furnace whose temperature could be controlled with an accuracy of ± 5°. IR spectra were recorded in the range 2000–400 cm⁻¹ with a Perkin–Elmer 983 spectrophotometer employing KBr pellet technique. The X-ray powder diffraction patterns were recorded in a Philips diffractometer using CuKα radiation.

Results and discussion

The TG and DTA runs of pure KIO₃ indicate that it melts at 560° with an endotherm and immediately decomposes to KI in the range 560–600°.

The TG curves of various mixtures are shown in Fig. 1 which indicate a single step reaction for all the mixtures except for the 3 : 1 mixture wherein two steps are observed. Noticeably, in all the case, the mass loss sets in at a temperature of ~ 435° which is much below the decomposition temperature of either of the reactants. The temperature of the completion of the reaction ranges from 475° for the 1 : 3 mixture and gradually increases to 525° for the 2 : 1 and to 600° for the 3 : 1 mixture. Thus,