PREPARATION AND CRYSTALLOGRAPHIC STUDIES OF STRONTIUM PLUTONATE

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Although complex oxide systems of plutonium with divalent metal ions have been found to be possible in number of cases (Russell *et al* 1960; Chackraburtty *et al* 1963), yet so far no difinite crystallographic studies have been reported about the complex oxide system of plutonium with strontium ion.

Specpure strontium carbonate was heated to its oxide, which was mixed with freshly prepared plutonium dioxide in the ratio necessary for the formation of $SrPuO_3$ and finally was heated to 1300°C–1500°C in tantalum crucible in a resistance furnace similar to that described by Drummond *et al* (1957). The diffraction patterns of the samples were taken in a 19 cm. Unicam camera in copper radiation. In addition to diffraction lines due to unreacted plutonium dioxide, extra lines were noticed which could be partly indexed by a cubic cell. By assuming simple shear of the cubic cell leaving '*a*' and '*c*' axis equal but '*b*' axis slightly different, a monoclinic cell was obtained which could explain the data with a $a = 4.280 \pm 0.006$ Å, $b = 4.276 \pm 0.006$ Å, $c = 4.280 \pm 0.006$ Å and $\beta = 92° 28'$, having one formula unit per cell. The substance was found to be isostructural with $CaTiO_3$ (Megaw 1946, Naray Szabo 1943). Geometrically, the above lattice so obtained could have ortho-rhombic symmetry and could be referred to a new *a* and *c* axes which were the diagonals of the (010) face of the monoclinic cell. The orthorhombic cell, derived from this consideration, has the following values: $a = 5.980 \pm 0.006$ Å, $b = 4.276 \pm 0.006$ Å and $c = 6.114 \pm 0.006$ Å. The '*b*' face, in this case, appeared to be face-centred. Indexing of the lines could be done on this basis, and from the consideration of symmetrical lattice obtained, the present (orthorhombic) indexing seems to be more preferable. For comparison, indexed data on monoclinic and orthorhombic cells are presented in Table I. Spectrophotometric studies indicated the valency of plutonium in IV state, hence it was concluded that strontium plutonate with a molecular formula $SrPuO_3$ was a complex oxide system in the group of perovskite compounds.

TABLE I

Date for $SrPuO_3$ (λ=1.5418 Å)

Orthorhombic unit cell is derived from monoclinic cell

dÅ*	$q_o^2 \times 10^{-4}$	$q_c^2 \times 10^{-4}$	Monoclinic indexing** hkl	Orthorhombic indexing*** hkl	Intensity
4.278	325	325	100	010, 101	
3.046	641	636	101	002	v.w.
3.015	645	650	011	111	v.s.
2.982	668	664	101	200	w+
2.498	954	961	$11\bar{1}$	012	w−
2.461	981	989	111	210	w.
2.133	1306	1300	200	020	m+
1.756	1926	1922	$21\bar{1}$	113	m.
1.739	1977	1978	211	311	m+
1.536	2536	2544	$20\bar{2}$	004	w.
1.512	2601	2600	022	212	m.w.
1.497	2656	2653	202	400	m.w−
1.350	3260	3250	031	131, 313	m+
1.281	3619	3617	311	412	v.w.
1.186	4224	4225	032	323	w.
1.137	4598	4592	321	422	w.

*For unreacted plutonium dioxide the following d(Å) values are obtained (in brackets estimated intensities are given): 3.112(m+); 2.698 (w); 1.910(m+); 1.628 (m); 1.558(w−); 1.239 (w); 1.208 (w); 1.104 (w); 1.039 (w−); 0.913α_1, (w+); 0.855α_1, (w); 0.824α_1 (w). These lines could be indexed with cubic cell a=5.40 Å (fluorite type).

**For monoclinic indexing, as $a^*=b^*=c^*$, by equivalence number of hkl indices are possible for many of the indexing planes.

***From the indexed data in orthorhombic case, the possible conditions limiting the reflections are, for hkl planes, h+l=2n present; hoo planes, h=2n present and 001 planes, l=2n present. This could indicate a B centred lattice.

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