Thermodynamic Properties of the Platinum Metals on ITS-90

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Selected properties taken from recent reviews written by the present author of the thermodynamic properties on the International Temperature Scale, ITS-90, are listed in the Tables below (1, 2). Values in these reviews correspond to a standard state pressure of one bar and have been corrected to the 1993 atomic weights (3): ruthenium 101.07, rhodium 102.90550, palladium 106.42, osmium 190.23, iridium 192.217 and platinum 195.08 (revised to 195.078 in 1995) (4).

Selected values for solid rhodium and iridium at 298.15 K and below are based on the assessments of Furukawa, Reilly and Gallagher (5).

Table I
Low Temperature Properties

	Ru	Rh	Pd	Os	Ir	Pt
Superconducting temperature (T_c), K	0.48	0.000325	–	0.64	0.1125	–
Electronic specific heat coefficient (γ), mJ/mol K^2	3.00	4.65	9.42	2.05	3.20	6.54
Debye temperature (θ_D), K	550	512	272	467	420	236

Table II
Properties at 298.15 K (solid)

	Ru	Rh	Pd	Os	Ir	Pt
Specific heat ($C°_p$), J/mol K	24.05	24.90	25.85	24.69	25.09	25.65
Enthalpy ($H°_{298.15} - H°_0$), J/mol	4577	4914	5444	4992	5266	5694
Entropy ($S°$), J/mol K	28.50	31.56	37.64	32.56	35.49	41.53
Heat of sublimation ($\Delta H°_{298.15}$), kJ/mol	649	558	377	788	670	565

Table III
Properties at 298.15 K (gas)

	Ru	Rh	Pd	Os	Ir	Pt
Specific heat ($C°_p$), J/mol K	21.524	21.014	20.786	20.788	20.788	25.531
Enthalpy ($H°_{298.15} - H°_0$), J/mol	6235.2	6206.6	6197.4	6197.4	6197.4	6576.6
Entropy ($S°$), J/mol K	186.509	185.827	167.066	192.579	193.584	192.409

Table IV

Melting Point Properties

	Ru	Rh	Pd	Os	Ir	Pt
Melting point, K *	2606	2236	1828.0	3400	2719	2041.3
Heat of fusion ($\Delta H^{o}s$, l), kJ/mol	39.0	27.3	16.1	70.0	41.3	21.3
Entropy of fusion ($\Delta S^{o}s$, l), J/mol K	15.0	12.2	8.8	20.6	15.2	10.4
Vapour pressure, bar	1.05×10^{-5}	5.05×10^{-6}	4.23×10^{-5}	7.75×10^{-5}	9.84×10^{-6}	1.90×10^{-7}

* The melting points of all but Os are proposed secondary fixed points on ITS-90 (6)

Table V

Vapour Pressures

Pressure, bar	Temperature, K					
	Ru	Rh	Pd	Os	Ir	Pt
1×10^{-12}	1684	1468	1060	2048	1751	1489
1×10^{-11}	1772	1546	1122	2156	1844	1569
1×10^{-10}	1871	1634	1191	2277	1949	1659
1×10^{-9}	1982	1733	1269	2411	2065	1759
1×10^{-8}	2107	1845	1359	2563	2197	1872
1×10^{-7}	2249	1972	1462	2736	2347	2002
1×10^{-6}	2412	2119	1582	2934	2520	2156
1×10^{-5}	2602	2293	1725	3163	2721	2339
1×10^{-4}	2842	2508	1899	3435	2976	2556
1×10^{-3}	3134	2772	2120	3793	3288	2821
1×10^{-2}	3498	3102	2400	4239	3681	3149
1×10^{-1}	3965	3530	2765	4810	4193	3567
1	4588	4110	3259	5571	4894	4122
NBP	4592	4114	3263	5576	4898	4125

NBP: Normal boiling point at one atmosphere pressure (1.01325 bar)

References

1 J. W. Arblaster, *Platinum Metals Rev.*, 1994, **38**, (3), 119 (Pt)

2 J. W. Arblaster, *Calphad*, 1995, **19**, 327 (Pd), 339 (Ru), 349 (Os), 357 (Rh), 365 (Ir)

3 Commission on Atomic Weights and Isotopic Abundances, *Pure & Appl. Chem.*, 1994, **66**, 2423

4 Commission on Atomic Weights and Isotopic Abundances, *Pure & Appl. Chem.*, to be published

5 G. T. Furukawa, M. L. Reilly and J. S. Gallagher, *J. Phys.Chem. Ref. Data*, 1974, **3**, 163

6 R. E. Bedford, G. Bonnier, A. Maas and F. Pavese, *Metrologia*, to be published

Random Paramagnetic Platinum-Iridium Compound

A new class of magnetic behaviour, random quantum spin chain paramagnetism, is reported in a one-dimensional compound, $Sr_3CuPt_{1-x}Ir_xO_6$. Scientists at the Massachusetts Institute of Technology, (T. N. Nguyen, P. A. Lee and H.-C. zur Loye, *Science*, 1996, **271**, (5248), 489–491) prepared a solid solution between antiferromagnetic Sr_3CuPtO_6 and ferromagnetic Sr_3CuIrO_6. They found that the platinum:iridium ratio determined the magnetic behaviour of the solid solution; at $x = 0.5$, the system contained randomly distributed platinum and iridium sites having random but equal ferromagnetic and antiferromagnetic interactions.