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Crystallographic Properties of Platinum

NEW METHODOLOGY AND ERRATUM

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Equations are given to represent the lattice parameter thermal expansion of platinum from 293.15 K to the melting point at 2041.3 K. This treatment is intended to supersede a combination of dilatometric equations with corrections for thermal vacancy effects.

In the review of the crystallographic properties of platinum by the present author (1), the high-temperature data were represented by expressions derived from precision dilatometric thermal expansion measurements (Equations (i) and (ii)). Above 1000 K temperature, not only did length change measurements derived from lattice parameter measurements fail to agree with one another, they also showed marked scatter around the dilatometric results. The length change measurements were therefore unsuitable for calculating the lattice parameter thermal expansion. This problem was addressed by correcting the dilatometric data for thermal vacancy effects (Equations (iii) and (iv)), based on the consistent set of thermal vacancy parameters given in Table I and explained in the original review (1).

Table I

Thermal Vacancy Parameters for Platinum

Parameter	Symbol	Value
Thermal vacancy concentration at melting point	c_v	7×10^{-4}
Enthalpy of monovacancy formation	H_v^f	1.51 eV
Entropy of monovacancy formation	S_v^f	1.32k

Note: k is the Boltzmann constant, given at the time of publication of Reference (1) as 8.617385×10^{-5} *eV* K^{-1}

On reflection, this procedure is cumbersome and might be considered unsatisfactory. It has therefore been replaced here by Equations (v) and (vi) which are based on a combination of Equations (i) and (iii), and which represent the lattice parameter thermal expansion from 293.15 K to the melting point at 2041.3 K. Equation (v) agrees with a combination of Equations (i) and (iii)

High Temperature Dilatometric Thermal Expansion (293.15–2041.3 K)

$$\alpha^* = 7.08788 \times 10^{-6} + 1.04970 \times 10^{-8}\,T - 2.00846 \times 10^{-11}\,T^2 + 2.28200 \times 10^{-14}\,T^3 - 1.18453 \times 10^{-17}\,T^4 + 2.37348 \times 10^{-21}\,T^5\ K^{-1} \quad \text{(i)}$$

$$\delta L/L_{293.15\ K} = 7.08788 \times 10^{-6}\,T + 5.24850 \times 10^{-9}\,T^2 - 6.69487 \times 10^{-12}\,T^3 + 5.70500 \times 10^{-15}\,T^4 - 2.36906 \times 10^{-18}\,T^5 + 3.95580 \times 10^{-22}\,T^6 - 2.39745 \times 10^{-3} \quad \text{(ii)}$$

Thermal Vacancy Corrections (1300–2041.3 K)

$$\alpha^*_{(lattice)} = \alpha^*_{(dilatometric)} - (5841/T^2)\ e^{(1.32\,-\,17523/T)}\ K^{-1} \quad \text{(iii)}$$

$$\delta a/a_{293.15\ K} = \delta L/L_{293.15\ K} - (1/3)\ e^{(1.32\,-\,17532/T)} \quad \text{(iv)}$$

Note: *In Equation (x) of Ref. (1), to which Equation (iv) corresponds, the second* δ *was incorrectly given as* d.

High Temperature Lattice Parameter Thermal Expansion (293.15–2041.3 K)

$$\alpha^* = 7.03139 \times 10^{-6} + 1.08937 \times 10^{-8}\,T - 2.10071 \times 10^{-11}\,T^2 + 2.36623 \times 10^{-14}\,T^3 - 1.20728 \times 10^{-17}\,T^4 + 2.34219 \times 10^{-21}\,T^5\ K^{-1} \quad \text{(v)}$$

$$\delta a/a_{293.15\ K} = 7.03139 \times 10^{-6}\,T + 5.44686 \times 10^{-9}\,T^2 - 7.00236 \times 10^{-12}\,T^3 + 5.91557 \times 10^{-15}\,T^4 - 2.41456 \times 10^{-18}\,T^5 + 3.90366 \times 10^{-22}\,T^6 - 2.39164 \times 10^{-3} \quad \text{(vi)}$$

to within 4×10^{-9} K^{-1} and to within $\pm 2 \times 10^{-9}$ K^{-1} overall, well within the accuracy of Equation (i) of $\pm 2 \times 10^{-8}$ K^{-1}.

In Equations (i), (iii) and (v), α^* is the thermal expansion coefficient relative to 293.15 K.

Erratum

In the review (1), equations were given representing a precision relationship between thermal expansion and specific heat. However, the third equation on page 19 of (1) (at the top of the right-hand column) was incorrectly given. It should have read:

$$\alpha = C_p(A + BT + \sum_{j=1}^{n} C_j T^{-j})$$

Reference

1 J. W. Arblaster, *Platinum Metals Rev.*, 1997, **41**, (1), 12

Launch of the Low Carbon and Fuel Cell Knowledge Transfer Network

On the 25th May, 2006, Fuel Cell Today (www.fuelcelltoday.com), along with its partners CENEX (the U.K.'s newly formed Centre of Excellence for Low Carbon and Fuel Cell Technologies), Fuel Cells UK and Foresight Vehicle, announced the launch of the Low Carbon and Fuel Cell Knowledge Transfer Network (LCFC-KTN).

This new development, designed to enhance the U.K.'s competitive position in emerging clean energy technologies, was instigated by the Department of Trade and Industry. The Network was launched simultaneously in Yokohama, Japan, at the Japan Society of Automotive Engineers congress.

Fuel Cell Today and the other KTN partners have combined their specialist knowledge to cover broad aspects of sustainable transportation (www.low-carbon-ktn.org.uk) and the full complement of commercial opportunities for fuel cells, from portable battery replacement through to power generation and transport applications. A principal aim is to accelerate the development and deployment of fuel cells in the U.K.

The KTN will provide a range of services to the U.K. low carbon and fuel cell community including a dedicated website, Business to Business facilities, networking opportunities, online conferencing, briefing notes, and expert opinions on technology and policy. The launch of the KTN is timely. As the commercial phase of fuel cell development gets underway, the U.K. fuel cell community now has a real opportunity to influence domestic and even worldwide markets.

The advent of the Low Carbon and Fuel Cell Technology KTN is evidence that the U.K. Government is reshaping its approach to boosting U.K. fuel cell industry capabilities and competitiveness in line with broader international industry trends. Currently, the U.K. does not sit with the United States, Japan, Canada and Germany in the first tier of international fuel cell development, but it has an undeniable depth of expertise which bodes well for the future. The U.K. also has some of the most innovative companies in the business. With effort, and continued Government support, the U.K. might yet take a place at the top table.

The Fuel Cell KTN website can be viewed at: www.fuelcellktn.com. For further information on this KTN and the services which it offers, contact: moderator@fuelcellktn.com.

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Mike Hugh is the Moderator of the Fuel Cell Technology Knowledge Transfer Network website. He is interested in fuel cell paths to market and the corresponding policy process. He is on the staff of Fuel Cell Today, and his Ph.D. thesis focused on drivers and barriers for stationary fuel cell markets in the U.K.

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