is the Na^+ transport number, F is the faradays of charge, R is the ideal gas constant, T is the absolute temperature, C_A and C_B are the concentrations of salt in each compartment, γ_A and γ_B are the respective mean molal ionic activity coefficients, Λ_∞ is the equivalent conductance at infinite dilution, and b is the Onsager slope constant. If the same handbook values for the P_{max} condition used by Clampitt and Kiviat are substituted in Eq. 2, we obtain

$$P_{max} = \frac{1.08 \times 10^{-3} an}{d_m r_m + 231\, d_{C_A} + 28.4\, d_{C_B}}$$

at 25°C.

Thus, in order to realize maximum theoretical power from a "seacell," the product of membrane specific resistivity and membrane thickness should approach zero. If we visualize a "pile" of plates and membranes 1 m on an edge, with intervening electrolyte compartments 0.01 cm wide, we can estimate the nature of the power dependence on r_m and gain an appreciation of the power-to-volume factor. If we generously concede that the state of the art will eventually permit membranes and plates 0.001 cm thick and electrolyte compartment concentrations maintained by countercurrent flow, the corresponding limiting P_{max} for $r_m = 0$ is 19 kw/m³. However, if r_m were on the order of 0.5 megohm-cm, the limiting P_{max} would be 98 watt/m³, just about enough to maintain a feeble incandescent lamp. It appears that the success or failure of efforts to develop a practical "seacell" depends on the availability of rugged and long-lived, low-impedance permselective membranes.

ALBERT F. HADERMANN
Applied Physical Chemistry, Inc.,
Route 1, Ijamsville, Maryland 21754

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Hexagonal (Wurtzite) Silicon

The existence of a hexagonal form of silicon with a wurtzite-type structure and with lattice parameters of $a = 3.80$ Å and $c = 6.28$ Å was established in 1963 (*1*). The pertinent data are given in (*1*) and also in various collections of structural data, most notably *Crystal Data* (*2*) and the *Handbook of Lattice Spacings and Structures of Metals* (*3*).

A new claim for the identification of wurtzite silicon has now been made by Jennings and Richman (*4*), who report very different lattice parameters, namely, $a = 4.04$ Å and $c = 6.60$ Å. We believe this claim to be incorrect, and we wish to make clear that there is no ambiguity regarding the nature of wurtzite silicon.

For the established wurtzite structure (*1*) the interatomic distance d (2.35 Å) and the density (2.33 g/cm³, calculated and measured) are the same as for cubic silicon with the diamond structure. On the other hand, the cell proposed by Jennings and Richman would give untypical values of 2.48 Å for the silicon-silicon distance and 2.00 g/cm³ for the density, 14 percent less than the density of cubic silicon. No experimental density is given by Jennings and Richman.

The most significant weakness in the new claim, however, is that the proposed unit cell is not supported by the observed diffraction data. By any reasonable criterion there is a serious lack of correspondence between the calculated and observed patterns in table 1 of (*4*). It is quite unacceptable to consider 3.5 Å (calculated d_{100}) as agreeing with 3.79 Å (observed d_{100}). The occurrence of strong and medium intensities at d-spacings not compatible with the unit cell is equally serious, for example, the d-spacings of 2.88, 2.67, and 2.46 Å. These are the more serious deficiencies in the purported correspondence of the patterns. Curiously, the calculated intensities are not those for silicon. They are the calculated intensities for hexagonal diamond reported by Bundy and Kasper (*5*).

Table 1. Debye-Scherrer pattern for wurtzite silicon: $a = 3.80$ Å, $c = 6.28$ Å; space group, $P6_3/mmc$; atoms in 4(f) ± (1/3, 2/3, z; 2/3, 1/3, 1/2 + z), where $z = 1/16$. Abbreviations: vs, very strong; ms, medium to strong; m, medium; and w, weak.

hkl	d_{calc} (Å)	d_{obs} (Å)	Intensity I_{obs}	Intensity I_{calc}
100	3.29	3.30	m	10
002*	3.14	3.15	vs	6
101	2.91	2.92	m	6
102	2.27			3
110*	1.90	1.90	ms	8
103	1.77	1.77	m	8
200	1.65			1
112*	1.63	1.63	m	5
201	1.59			1
004	1.57			0
202	1.46			1
104	1.42			0
203	1.29	1.30	w	3
210*	1.24			1
211	1.22			1
114	1.21			0
105	1.17	1.17	w	2
212	1.16			3
204	1.14			0
300*	1.10			1
213	1.07	1.08	w	3

*Reflections coincident with or overlapping those of cubic silicon.

Jennings and Richman refer to the original report on wurtzite silicon (*1*) but state inaccurately that only a hexagonal phase with $a = 3.80$ Å and $c = 6.28$ Å, but presumably not the wurtzite structure, was observed. They emphasize that the diffraction pattern was not published. We admit the desirability of publishing the pattern but not for the reasons considered important by Jennings and Richman. A typical pattern obtained with CuKα radiation is given in Table 1. As mentioned in (*1*), patterns for specimens of dense silicon heat-treated in the range of 150° to 200°C showed varying amounts of the initial dense silicon and of cubic silicon in addition to the hexagonal wurtzite form. The specimen providing the pattern of Table 1 was heated to 200°C and maintained at that temperature for 30 minutes. Only one very faint line at 2.65 Å (probably the most intense line of dense silicon) is not included in Table 1. The indexing is quite satisfactory and the intensity agreement acceptable (some cubic silicon is probably present). This wurtzite pattern does not correspond at all to the observed pattern of Jennings and Richman. We conclude that their specimen might possibly contain wurtzite silicon as a minor constituent as well as some cubic silicon; it is difficult, however, to ascertain what the preponderant portion of the specimen may be and it is not clear that only one phase is involved, because several strong or medium lines remain unidentified.

For the record, we wish to correct the statement [included in (*4*)] that the specific volume of dense silicon is 1.9 percent less than that of the cubic diamond form of silicon. The appropriate figure is 9.4 percent.

J. S. KASPER
R. H. WENTORF, JR.
General Electric Corporate Research
and Development Center,
Post Office Box 8,
Schenectady, New York 12301

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