Conclusion

The interpretation of their observations given by Kaul & Saxena (1977) is, in our opinion, to be dismissed entirely. The experiments reported correspond to the oxidation of the hydride LnH_2 (Ln = Dy, Er) into the *C*-type sesquioxide Ln_2O_3 (Ln = Dy, Er). They ignore the high gettering power of rare-earth-metal thin films, which causes the formation of chemical compounds other than the oxides.

References

BOULESTEIX, C., PARDO, B., GASGNIER, M., HENRY LA BLANCHETAIS, CH. & CARO, P. (1974). *Phys. Status Solidi A*, **23**, 597–604.

BRAUER, G., BÄRNIGHAUSEN, H. & SCHULTZ, N. (1967). *Z. Anorg. Allg. Chem.* **536**, 46.

CADIM, M. & AL-BASSAM, T. S. (1977). *Thin Solid Films*, **41**, L9–L10.

CURZON, A. E. & CHLEBEK, H. G. (1973*a*). *J. Phys. F*, **3**, 1–5.

CURZON, A. E. & CHLEBEK, H. G. (1973*b*). *J. Phys. F*, **3**, L176–L178.

CURZON, A. E. & CHLEBEK, H. G. (1973*c*). *J. Less-Common Met.* **32**, 365–369.

CURZON, A. E. & SINGH, O. (1975*a*). *J. Less-Common Met.* **39**, 227–233.

CURZON, A. E. & SINGH, O. (1975*b*). *J. Phys. D*, **8**, 1703–1708.

CURZON, A. E. & SINGH, O. (1977*a*). *Thin Solid Films*, **41**, L25–L27.

CURZON, A. E. & SINGH, O. (1977*b*). *Thin Solid Films*, **44**, 233–240.

DEXPERT-GHYS, J., LOIER, CH., HENRY LA BLANCHETAIS, CH. & CARO, P. (1975). *J. Less-Common Met.* **41**, 105–113.

DUFECK, V., BRONZEK, V. & PETRIE, F. (1969). *Monatsh. Chem.* **100**, 1628.

EICK, H. A., BAENZIGER, N. C. & EYRING, L. (1956). *J. Am. Chem. Soc.* **78**, 5147–5150.

FELMLEE, T. L. & EYRING, L. (1968). *Inorg. Chem.* **7**, 660–666.

GASGNIER, M. (1975). *J. Less-Common Met.* **41**, 351–354.

GASGNIER, M., GHYS, J., SCHIFFMACHER, G., HENRY LA BLANCHETAIS, CH., CARO, P. & BOULESTEIX, C. (1974). *J. Less-Common Met.* **34**, 131–142.

GASGNIER, M., HENRY LA BLANCHETAIS, CH. & CARO, P. (1976). *Thin Solid Films*, **31**, 283–295.

HOLLOWAY, D. M. & SWARTZ, W. E. JR (1977). *J. Vac. Sci. Technol.* **14**, 1192–1195.

JOHNSON, D. A. (1969). *J. Chem. Soc. A*, pp. 1525–1530, 2578–2580.

KAUL, V. K. & SAXENA, U. (1977). *Acta Cryst.* A**33**, 992–996.

KUNZMANN, P. & EYRING, L. (1975). *J. Solid State Chem.* **14**, 229–237.

MCCARTHY, J. & WHITE, W. B. (1970). *J. Less-Common Met.* **22**, 409–417.

MÜLLER, J., SINGH, B. & SURPLICE, N. A. (1972). *J. Phys. D*, **5**, 1177–1184.

MURR, L. E. (1967). *Phys. Status Solidi*, **24**, 135–148.

MURR, L. E. (1972). Private communication.

PARDO, B. & ZOGHEIB, H. (1974). *Phys. Status Solidi A*, **24**, 91–97.

SAFRAI, M., BUCKWALD, R. A. & HIRSCH, A. A. (1976). *Solid State Commun.* **20**, 349–352.

SEMILETOV, S. A., IMANOV, R. M. & RAGIMLI, N. A. (1974). *Sov. Phys. Crystallogr.* **19**, 386–388.

SEMILETOV, S. A., IMANOV, R. M. & RAGIMLI, N. A. (1976). *Thin Solid Films*, **32**, 325–328.

SURPLICE, N. A. (1976). *Thin Solid Films*, **37**, L15–L16.

TSUTSUMI, T. (1970). *Jpn. J. Appl. Phys.* **9**, 735–739.

WORK, D. E. & EICK, H. E. (1972). *J. Less-Common Met.* **26**, 413–416.

Acta Cryst. (1978). A**34**, 1027–1028

Determination of electronic polarizabilities of ions in orthosilicates.

By D. POHL, J. C. ECK & K.-H. KLASKA, *Mineralogisch-Petrographisches Institut der Universität Hamburg, Grindelallee* 48, *D*2000 *Hamburg* 13, *Federal Republic of Germany*

(*Received* 16 *March* 1978; *accepted* 4 *July* 1978)

Electronic polarizabilities of cations have been obtained for the sodium *D* line (in Å^3): Mg^{2+} 0·1, Fe^{2+} 3·3, Zn^{2+} 5·4, Zr^{4+} 4·6. The polarizability of the O^{2-} ion varies from one structure to another. It has been shown that calculation of electronic polarizability is possible only if an accurate structure refinement is available.

Recently, a method of determining electronic polarizabilities of ions in crystals has been given by Pohl (1978). If both optical and structural data are available, polarizabilities can be obtained for the ions composing the structure of a doubly refracting crystal. This method has been applied to orthosilicates containing just one type of cation: Be_2SiO_4, Mg_2SiO_4, Fe_2SiO_4, Zn_2SiO_4 and $ZrSiO_4$. In applying the method, it is assumed that the polarizability of the Si^{4+} ion is negligible compared to that of the other ions. Since this assumption does not hold for Be_2SiO_4, this compound was assumed to contain only one type of polarizable ion, namely O^{2-}. Refractive indices were obtained from the compilation by Winchell & Winchell (1964). On the basis of recent structural data (see references in Table 1) electronic polarizability values for λ = 5893 Å (sodium *D* line) were computed. The results are given in Table 1. For comparison,

Table 1. *Orthosilicates: electronic polarizabilities of ions (in Å^3)*

Cation	α_{cation} (Pauling)	α_{cation} (Present paper)	$\alpha_{O^{2-}}$	Refinement
Be^{2+}	0·1	–	16·9	(*a*)
Mg^{2+}	1·2	0·1	19·8	(*b*)
Fe^{2+}	–	3·3	23·8	(*b*)
Zn^{2+}	3·6	5·4	21·8	(*c*)
Zr^{4+}	4·7	4·6	22·0	(*d*)

(*a*) Zachariasen (1971). (*b*) Birle, Gibbs, Moore & Smith (1968). (*c*) Klaska, Eck & Pohl (1978). (*d*) Robinson, Gibbs & Ribbe (1971).

Pauling's (1927) polarizabilities of Be^{2+}, Mg^{2+}, Zn^{2+} and Zr^{4+} are also given.

The agreement between the cation polarizabilities from Pauling's (1927) work and those from the present paper is passably close. For the polarizability of the O^{2-}, there is no value common to all orthosilicates.

When we first applied our calculations to willemite (Zn_2SiO_4), we used the structure refined by Chin'Hang, Simonov & Belov (1970). On the basis of this structure, however, we were unable to evaluate polarizabilities. For example, if we assumed reasonable values for the polarizabilities, the calculated birefringence was negative, while experimentally it was positive. On the other hand, we obtained the correct sign for the birefringence of phenacite (Be_2SiO_4), which is isostructural with willemite. Since the calculated refractive indices depend strongly on the shortest distances between highly polarizable ions, we doubted that the refinement of willemite had yielded accurate or nearly accurate coordinates. The rather unusual Si–O bond lengths determined by Chin'Hang, Simonov & Belov (1970) strengthened this doubt. Fortunately, a hydrothermally grown single crystal of willemite was available to us. We therefore decided to refine this structure for our use. The results of our refinement are given in a separate paper (Klaska, Eck & Pohl, 1978). The coordinates of the re-refinement allowed a superior calculation of the desired polarizabilities to be made. Thus, it has been shown that accurate coordinates are necessary to evaluate refractive indices from structural data. Conversely, in special cases calculation of optical properties can serve as a test for the accuracy of a structure refinement.

References

BIRLE, J. D., GIBBS, G. V., MOORE, P. B. & SMITH, J. V. (1968). *Am. Mineral.* **53**, 807–824.

CHIN'HANG, SIMONOV, M. A. & BELOV, N. V. (1970). *Sov. Phys. Crystallogr.* **15**, 387–390.

KLASKA, K.-H., ECK, J. C. & POHL, D. (1978). *Acta Cryst.* B**34**. In the press.

PAULING, L. (1927). *Proc. R. Soc. London Ser. A*, **114**, 181–211.

POHL, D. (1978). *Acta Cryst.* A**34**, 574–578.

ROBINSON, K., GIBBS, G. V. & RIBBE, P. H. (1971). *Am. Mineral.* **56**, 782–790.

WINCHELL, A. & WINCHELL, H. (1964). *The Microscopic Characteristics of Artificial Inorganic Solid Substances.* New York: Academic Press.

ZACHARIASEN, W. H. (1971). *Sov. Phys. Crystallogr.* **16**, 1021–1025.

Acta Cryst. (1978). A**34**, 1028–1029

High-flux micro-resonators for X- and γ-ray lasers.

By W. A. DENNE,* *CSIRO, Division of Chemical Physics, PO Box* 160, *Clayton, Victoria* 3168, *Australia*

(*Received* 7 *October* 1977; *accepted* 21 *July* 1978)

It is shown that a small single crystal may resonate at a wide range of X- and γ-ray frequencies. Such a resonator should produce roughly 10^{11} times greater radiative flux density per photon than previous designs.

A high-flux resonant cavity is an essential component of a successful continuous-wave X- or γ-ray laser. A number of such devices have been described by various authors (Bond, Duguay & Rentzepis, 1967; Cotterill, 1968; Deslattes, 1968; Kolpakov, Kuz'min & Ryaboy, 1970; Navasardyan, 1973). In each case the operation depends on a series of Bragg reflexions from large perfect crystals, and, in the main, these devices have planar or near-planar X-ray paths. Such a configuration suffers from a number of disadvantages, which may be listed as follows:

(1) It is difficult to design such a device with a resonant volume of less than a few tens of cubic millimetres. This implies relatively low radiative flux densities which in turn reduces the possibility of stimulated emission.

(2) Losses in the reflectors are additional to losses in the active medium and therefore represent an unnecessary inefficiency.

(3) Divergence of the beam at right angles to the diffraction plane is not unduly restricted; this leads to a progressive reduction in the radiative flux density.

(4) Multiple scattering is likely to be a severe source of loss, especially for almost symmetric crystals and short wavelengths; this appears to have been ignored in earlier work.

(5) The machining and precise alignment of large perfect crystals is not a trivial task.

Most of these problems may be overcome by generating

* Present address: 2 Draycott Road, Southmoor, Oxford, England.