Letters to the Editor

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Compressional Piezoelectric Coefficients of Monoclinic Crystals

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IN two recent publications[1,2] Mason has given a complete set of piezoelectric coefficients d_{nm} for the monoclinic polar crystals potassium tartrate hemihydrate (DKT) and ethylene diamine tartrate (EDT). In addition to shear piezoelectric coefficients referring to electric fields perpendicular to the polar axis, crystals of this class have piezoelectric coefficients d_{21}, d_{23}, and d_{25}, relating an electric displacement parallel to the polar (Y) axis with a general stress in the plane perpendicular to this axis, and a coefficient d_{22} relating the same electric displacement with a compressional stress parallel to the Y axis. The sum $d_{21}+d_{22}+d_{23}$ should give the electric displacement parallel to Y caused by hydrostatic pressure.

According to Mason's values for these coefficients,[2] the hydrostatic piezoelectric effect of ethylene diamine tartrate should be the highest known for any crystal. A direct measurement, however, showed an effect only about one-seventh as large as derived from Mason's data. We therefore undertook direct measurements of the piezoelectric coefficients relating to fields parallel to Y by determining the charge developed on the Y face upon removal of a load from the side faces of bars having their length perpendicular to Y at various azimuths. The results are given in Table I.

TABLE I.

	EDT	DKT	DKT*
d_{21}	$+11.3\pm1$	-0.5 ± 0.3	-0.8
d_{23}	-12.3 ± 1	-4.9 ± 0.5	-4.8
d_{25}	-18.4 ± 2	-5.9 ± 2	-6.3
d_{22}	$+\ 1.8\pm0.5$	$+3.4\pm0.5$	$+4.9$
d_{hydro}	1.9 ± 0.2	1.3 ± 0.2	
Temp.	25°C	25°C	20°C

* See reference 3.

The unit in this table is 10^{-12} coulomb/newton ($=3.10^{-8}$ e.s.u.). The values of Spitzer[3] were arranged to conform to our convention on axes which is identical with that of Mason and is based on the standards proposed by the Committee on Piezoelectricity of the I.R.E.[4] The writer has recently been informed by Dr. Mason that new determinations of the signs of the piezoelectric coefficients of EDT and DKT are in agreement with those given in this letter.

I am obliged to Mr. James Mumper for carrying out most of the reported measurements.

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[1] W. P. Mason, Phys. Rev. **70**, 705 (1946).

[2] W. P. Mason, Proc. I.R.E. **35**, 1005 (1947).

[3] F. Spitzer, Dissertation, Goettingen (1938).

[4] Standards on Piezoelectric Crystals (Institute of Radio Engineers, 1948), in print.

Remarks on Diamond Crystal Counters

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May 6, 1948

IN a letter with the above title, Robert Hofstadter[1] has quoted the x-ray studies of R. S. Krishnan[2] and G. N. Ramachandran[3] as indicating that ultraviolet opaque (type I) diamonds have an essentially mosaic structure.

This is quite definitely not the case. The diamonds which show "type I" effects *most clearly* are neither mosaic nor laminated; and contrary to my previous opinion, they are not even in a state of strain; they are, in fact, about the nearest approach to a *perfect* crystal that we know. Krishnan and Ramachandran both confirmed this. If a really good type I and a type II diamond are compared under similar conditions, it will be found:

(1) that the diffraction of a narrow pencil of x-rays by the type I diamond is several times less intense than that of the type II;[4,5]

(2) that the absorption pattern given by a divergent beam of x-rays[6] is invisible for the type I diamond, but well-defined for the type II diamond.

Both these observations are evidence of strong primary extinction in type I diamonds and show their near-perfection. It is quite true, on the other hand, that really good type I diamonds are comparatively rare; some diamonds appear to be a mixture of the two types; others intermediate between them.

Good type II diamonds do appear to be laminated; and, if it is this type of diamond that makes the best "gamma-ray counter," then it would seem to be at least possible that the secondary electrons counted are those which move along the boundaries and not through the crystal proper. In this case the reorientation experiment suggested by R. Hofstadter might well show a positive result, but it would neither prove nor disprove Sir C. V. Raman's theory[7] that four kinds of diamond exist.

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[1] R. Hofstadter, Phys. Rev. **73**, 631 (1948).

[2] R. S. Krishnan, Proc. Ind. Acad. Sci. **A19**, 298 (1944).

[3] G. N. Ramachandran, Proc. Ind. Acad. Sci. **A19**, 304 (1944).

[4] K. Lonsdale, Proc. Roy. Soc. London **A179**, 315 (1942); Nature, London **153**, 669 (1944).

[5] P. S. Hariharan, Proc. Ind. Acad. Sci. **A19**, 261 (1944).

[6] K. Lonsdale, Nature **153**, 22 (1944); Phil. Trans. Roy. Soc. **A240**, 219 (1947).

[7] Sir C. V. Raman, Proc. Ind. Acad. Sci. **A19**, 189 (1944).