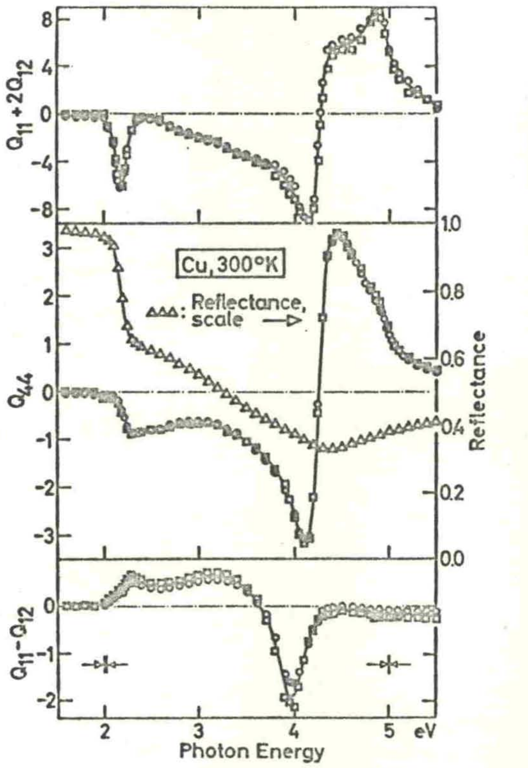

FIG. 7. The relative change of the reflectance of Cu per strain for a change in volume ($Q_{11}+2Q_{12}$) and for trigonal (Q_{44}) and tetragonal ($Q_{11}-Q_{12}$) shear strain, evaluated from the six functions of Fig. 6 as indicated in Table II. The definition of the functions Q_{ij} is given in Table I. The room-temperature reflectance of Cu is also included.

these six measured functions is that of three functions only, e.g., $Q_{11}+2Q_{12}$, Q_{44}, and $Q_{11}-Q_{12}$ as given in Table I. There are in fact two measurements for each of the independent functions. Table II lists the measurements that were used to determine the Q_{ij}; Fig. 7 gives the three functions, together with the reflectance for zero strain. The deviations between points belonging to the same function but originating from different measurements is small; the error signal per strain along the stress axis, estimated from the remaining deviations is approximately ± 0.2. This is about 2% of the maximum signal observed which is $Q_{11}+2Q_{12}=9$ at $\hbar\omega=4.15$ eV.

Figure 8 contains the change of ε_2 resulting from the three independent symmetry distortions, expressed in terms of W_{ij} (see Table I). The function ϵ_2 for zero strain is also included. The quantities W_{ij} were obtained from a Kramers-Kronig analysis of the Q_{ij}. The values for Q_{ij} for $\hbar\omega<1.5$ eV and $\hbar\omega>5.5$ eV are not known. The functions Q_{ij} are zero between 2 and 1.5 eV. The contribution of the free carrier absorption to Q_{ij} remains small further in the infrared.[11] We therefore used $Q_{ij}=0$ as the extrapolation below 1.5 eV. The functions Q_{ij} are small at 5.5 eV, but they are not zero. There are probably nonzero values further in the ultraviolet. In doing the Kramers-Kronig transform, we joined the

TABLE II. Reduction of the measured relative change of the reflectance to the piezo-optical constants Q_{ij}.

Q_{ij}	Determined from	Stress axis	Points in Fig. 7
$Q_{11}+2Q_{12}$	$\Delta R/R^{\parallel}+2\Delta R/R^{\perp}$	[111]	Circles
	$\Delta R/R^{\parallel}+2\Delta R/R^{\perp}$	[001]	Squares
Q_{44}	$\Delta R/R^{\parallel}-\Delta R/R^{\perp}$	[111]	Circles
	$2\Delta R/R^{\parallel}+\Delta R/\Delta^{\perp}$ and $Q_{11}+2Q_{12}$	[110]	Squares
$Q_{11}-Q_{12}$	$\Delta R/R^{\parallel}-\Delta R/R^{\perp}$	[001]	Circles
	$\Delta R/R^{\perp}$ and $Q_{11}+2Q_{12}$	[110]	Squares

functions Q_{ij} smoothly with the zero line for $\hbar\omega>5.5$ eV. In order to evaluate the error introduced by this approximation, another Kramers-Kronig transform was done on $Q_{11}+2Q_{12}$. This time the function was extrapolated to the minimum $Q_{11}+2Q_{12}=-2$ at 6 eV and joined smoothly with the zero line above 6.5 eV. The deviation in $W_{11}+2W_{12}$ for the two extrapolations is 5 at 5.5 eV; this is 6 % of the maximum value (81.5 at 4.3 eV). The weighting function in the Kramers-Kronig integral assures that the error due to the extrapolation decreases with decreasing energy. The error bars near 5.5 eV in Fig. 8 give the deviation due to the extrapolation discussed above, whereas the ones at 3.5 eV give the uncertainty produced by the error signal in $\Delta R/R$.

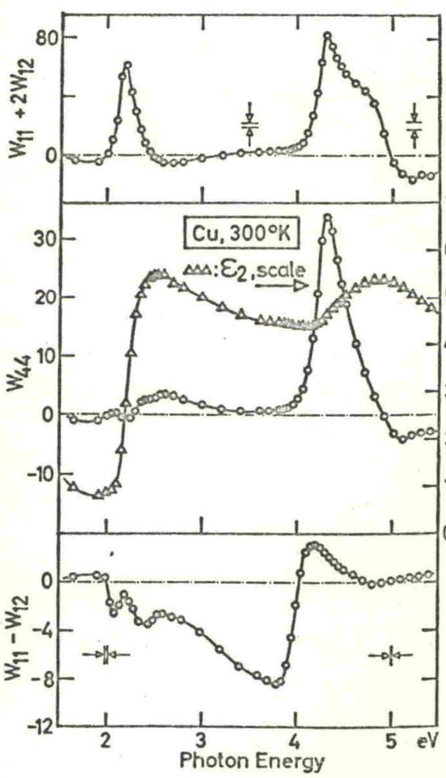

FIG. 8. The change of the imaginary part of the dielectric constant of Cu per strain for a change in volume ($W_{11}+2W_{12}$), for trigonal (W_{44}) and tetragonal ($W_{11}-W_{12}$) shear strain, and the imaginary part of the dielectric constant. The definition of the functions W_{ij} is given in Table I.