TABLE IV Values of $\phi(R_0)$ for the Ni–Cu system

Ni (%)	$\phi(R_0)$ (Ry) $\times 10^{-3}$
0	3.15
10	2.17
20	1.37
30	0.76
40	0.33
50	0.08
60	0.01
70	0.08
80	0.31
90	0.69
100	1.19

lation between the values $\phi(R_0)$ and the volume change during sintering process.

According to the results obtained, it can be seen that the volume changes correlate with the change of the inter-ion interaction in the domain of the nearest neighbours $[\phi(R_0)]$.

In conclusion, there is a correlation between inter-ion interaction of the nearest neighbours and dimension changes in the sintered system. According to the results from [5], the above correlation does not depend on time and sintering temperature. Since a similar analysis can be used for an n-component metallic system, it should be possible to predict the concentrations of different components which lead to the extreme volume changes during sintering.

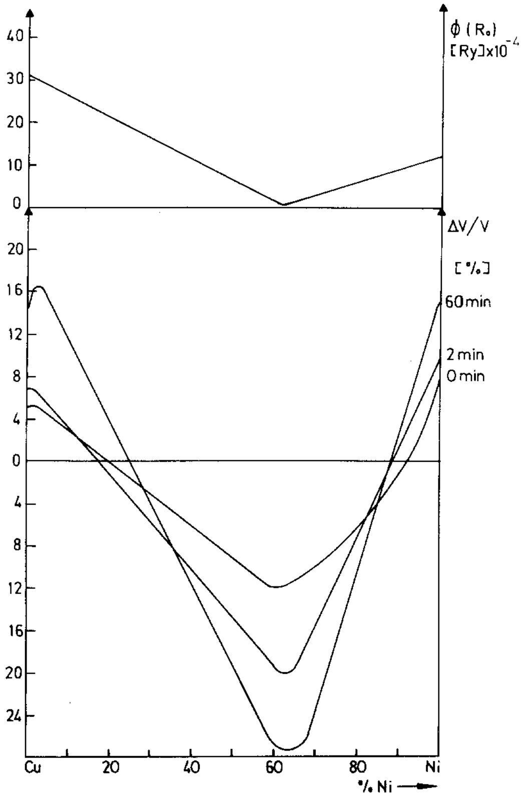

Figure 4 Correlations between the values $\phi(R_0)$ and volume ($\Delta V/V$) for the Cu–Ni system. The values for the changes of volume are from [2].

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The crystal structure and space group of the mineral shortite

A study of minerals by Fahey [1] from mines in the Green River area of Sweetwater County in Wyoming, USA, indicated that the mineral shortite exhibited the pyroelectric effect. As part of a survey of pyroelectric materials samples of this material [2] from the West Vaco mine in the above region were obtained and examined for this effect. The physical appearance of the crystals was exactly as described and single crystal X-ray data confirmed the symmetry as orthorhombic, and the indexing of the faces as correct. Chemical

TABLE I

Sample orientation	(1 0 0)	(0 1 0)	(0 0 1)
ϵ (at 1.6 kHz)	10.67	10.71	10.13
	10.61	8.30	
ρ(at 1.6 kHz, Ω cm)	2.9×10^9	7.4×10^8	3.9×10^9
	3.5×10^9	3.6×10^9	
Loss tangent (tan 8 at 1.6 kHz)	0.037	0.143	0.029
	0.031	0.038	
Pyroelectric coefficient (C cm^{-2} $^\circ$C^{-1})	0	$\ngtr 4.3 \times 10^{-10}$	0
Pyroelectric coefficient (after attempts to pole)	2.3×10^{-10}	1.8×10^{-10}	0
Hysteresis at 50 Hz	None	None	None

and spectrographic analysis [3] confirmed the formula (as $Na_2CO_3 2CaCO_3$) and the impurity content, except in the latter case some silicon and boron were present at a minimum level of 1000 p.p.m. by weight for the former and 10 p.p.m. by weight for the latter.

Evidence for pyroelectricity was sought by means of the charge integration technique and for ferroelectricity by seeking for dielectric hysteresis using a Sawyer–Tower circuit [4] modified to compensate for the saturation value of the sample capacitance [5]. The results of the measurements made at 20° C are as given in Table I.

These results indicate that the crystals exhibit only a weak pyroelectric effect if they exhibit the effect at all. The mineral has been assigned the acentric space group C2 mm on the basis of previous data [1] but on present data this cannot be supported. An explanation of this discrepancy could be that the mineral is a solid solution between sodium carbonate and calcium carbonate. The relevant phase diagram between the two carbonates [6, 7], shows the solid forming as a double salt plus calcite. If this is the case small differences in composition between crystals and in a given crystal are likely to result. These can lead to differences in crystal structure [8] and hence differences in physical properties which are sensitive to structure such as the pyroelectric effect. Thus some samples of the mineral could have shown the pyroelectric effect, whereas others would not do so.

Acknowledgement
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Fatigue crack tip displacement observations

The continuing study of fatigue crack propagation mechanisms has brought about the need for measurements within the plastic zone at the crack tip. Plastic zone size and shape have been measured with electron channelling [1, 2], etching [3], interferometry [4], and several other techniques, and positive replies have been used to measure slip offsets, and therefore strains, very near the crack tip [5]. This note describes another technique for visualizing and measuring these crack tip displacements using a stereo viewer.

The technique was discovered during the analysis of photographs made during propagation of a fatigue crack within the scanning electron microscope, utilizing an especially designed cyclic loading stage [6]. Photographs of the crack tip