24.1-12 HIERARCHY OF TRANSLATION GROUPS AT PHASE TRANSITIONS AND SYMMETRY PROPERTIES OF RECIPROCAL LATTICE. V.Sh.Shekhtman and N.S.Afonikova. Institute of Solid State Physics, the USSR Academy of Sciences, Chernogolovka, Moscow district 142432, USSR

A polydomain crystal of the phase F which was formed as a result of the transition $g \to F$ represents an appreciably new structural conglomerate that inherits symmetry properties of the point group of the initial phase $g \equiv \{g_1, \dots g_h\}$. This important peculiarity can be used to determine the number of equally probable orientation states (OS), i.e. the multiplicity of the $\{F_1, \dots, F_n\}$ domain system of a new phase. Let the exact expression for one matrix of deformation A_j responsible for the structure transformation be known. Using conjugations such as $g_i A_j g_i^{-1} = A_K$ we find a whole set of matrixes corresponding to a polydomain configuration. In this case among the h-conjugations we reveal the symmetry operations g_{st} which bring about the identical transformation of the matrix $g_{st} A_j g_{st}^{-1} = A_j$. Such stabilizers of the orbit $\{A_j\}$ form a group $\{g_{st}\} \subset g$. Next follows the evident equality $n = h/h_{st}$. It means that the number of non-equivalent deformation operations and, consequently, the number of OS of a new phase coincides with the index of "the stabilizers subgroup". The latter conclusion emphasizes that the multiplicity of the domain system is determined by symmetry relations under deformation of the initial lattice and is independent of the order of the final state group F. This result finds its corroboration in a variety of real structural transitions including those ones which are not the transitions into the subgroup (for example, the well-known martensite transition $\gamma \to \alpha$ Fe). Such an approach might be extended to the systems of twins as well to the transformations in the scheme of micro-heterogeneous deformation with the change in the number of points in the Bravais lattice.

In the X-ray studies of the crystal-geometry of phase transitions important is the representation of symmetry properties of a polydomain crystal in the reciprocal space. For a full system of the OS that the deformation scheme of phase transition allows, the "F^2-body" is shown as a superposition of identical reciprocal lattices which are brought into coincidence in the point 000 with the maintenance of mutual orientation angles. Both the analytical expressions and the illustrative constructions for two-dimensional arrays show that such a configuration keeps the symmetry of the initial point group. In this case the description of reciprocal space properties for a polydomain crystal necessitates attraction of the generalized symmetry concepts which are being developed in the soviet crystallographical school by Academicians Shubnikov and Belov. Really, to the turn elements of the group which transfer the individual reciprocal lattices in each other, one should also ascribe the operation of the OS "number" (colour) change. In the real space the relationship between orientation states may be described with the operations of the group g in addition to Prof. Koptsik's permutations.

24.1-13 X-RAY DETERMINATION OF THE DEGREE OF MICROSTRESS RELAXATION IN GLASS/CRYSTALLINE COMPOSITES. By E.A. Levi, N.V. Belov and E.A. Pobedimskaya, Department of Geology, Moscow State University, Leninskiye Gory, Moscow, USSR.

In composite materials the microstresses defined by a difference in thermal expansion coefficients (TEC) of individual components arise at the phase interface. These stresses lead to the formation of microcracks near the particles whose size exceeds the critical size; in this case, the nature of cracks is defined by symmetry of stress distribution in space. As a result, a partial relaxation of stresses occurs.

A method is proposed for determining the degree of stress relaxation in glass/crystalline materials

$$P = \frac{\varepsilon_{calc.} - \varepsilon_{obs.}}{\varepsilon_{calc.}} \quad \text{where } \varepsilon_{calc.}$$

is calculated from the Kingery formula with an account of anisotropy of thermal properties of crystals, the deformation $\varepsilon_{obs.}$ being measured by reference to the displacement of X-ray diffraction peaks of crystals. The X-ray diffraction analysis makes possible the study of microstress distribution in space.

The dependence of the degree of stress relaxation on the size of crystals and on the method for obtaining a composite is shown for glass/crystalline materials with rutile (Table). The directly proportional dependence of the composite strength on the degree of microstress relaxation is established for glass/crystalline materials with quartz and zircon (TEC of crystals are, correspondingly, higher or lower than TEC of glass). The dependence of residual stresses on the TEC difference at the phase interface depending on the degree of relaxation is studied. It is shown (for glass/crystalline composites) that the symmetry of residual microstress distribution in space obeys the crystal symmetry.

Thus the present work confirms experimentally the Devidge and Green's theory (Lange, Composite Materials (1974) 5, 1) about the influence of microstresses on the nature of composite fracture. The method for determining the microstress relaxation yield the structural characteristics associated with the strength of the material.

Table

N of samples	Materials	Maximum particle size	Stresses (kg/mm^2) Obs. σ_a	Obs. σ_c	Calc. σ_a	Calc. σ_c	P, %
1	Ceramics	100	303	457	2	25	98
2	Ceramics	100	111	196	2	46	92
3	Crystallized glasses	5	226	335	145	190	38
4	Crystallized glasses	5	211	315	155	144	34