

## STUDY OF THE DEFORMATION OF POLYCRYSTALLINE BERYLLIUM DURING COMPRESSION

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We earlier described the results of an x-ray investigation of the deformation of beryllium single crystals with various orientations in the process of compression [1]. These studies were performed in a special x-ray press-camera [2]. The change in character of the photographs as a function of the loads applied to the specimens made it possible to qualitatively trace the effect of elastic and plastic deformation on the structure of beryllium.

The object of the present work was to obtain quantitative information on the structure of deformed beryllium; it was decided to conduct the investigation on polycrystalline metal because Laue exposures of single crystals do not permit one to make precise measurements of the deformation of the crystal lattice. Beryllium is the only metal in which the two most important properties necessary for this sort of study are combined: "transparency" to x rays which permits one to obtain information about the deformation of the entire specimen and not only its surface layer, and the high compressive strength ( $\sigma_b \sim 100-140 \text{ kg/mm}^2$  at  $20^\circ\text{C}$ ) which makes it possible to work over a wide range of loads, especially in the plastic flow region.

Specimens for the study with dimensions  $2 \times 3 \times 5 \text{ mm}$  were cut out of billets of cast, deformed beryllium of  $\sim 99.9\%$  purity. The x-ray patterns were recorded in a multiframe cassette using the back-reflection method with iron radiation in a cell for deforming the specimens. The exposure geometry allowed reflections to be registered from the (201) and (112) planes and occasionally from the (103) planes. The relative precision of measurement of the interplanar spacings ( $\Delta d$ ) amounted to  $0.0002 \text{ \AA}$ . In preliminary experiments it was established that the change in interplanar spacings de-

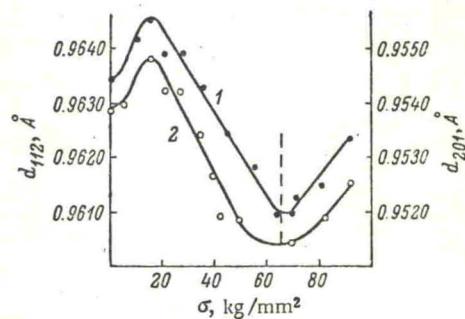


Fig. 1. The change in interplanar spacings  $d_{112}$  (1) and  $d_{201}$  (2) in polycrystalline beryllium as a function of stress under rapid loading.

pends on the length of time a specimen is subjected to load. Therefore the curves of  $d$  vs.  $\sigma$  were determined with two loading schemes: I: loading (5-10 min), exposure (3 h), loading, exposure, etc.; II: loading (5-10 min), constant load (20 h), exposure, loading, constant load, exposure, etc.

The dependence of the interplanar spacing  $[d(\sigma)]$  on load is shown in Fig. 1 for the two pyramidal planes (201) and (112). In the reflecting position under the arrangement used for the x-ray exposures, these planes make angles of  $\sim 22.5$  and  $\sim 24^\circ$  respectively with the axis of loading. The variations of  $d_{201}(\sigma)$  and  $d_{112}(\sigma)$  have identical character; three sections are observed in the curves:  $\sigma = 0-15 \text{ kg/mm}^2$ , where the interplanar spacings increase somewhat with increase in load;  $\sigma = 15-65 \text{ kg/mm}^2$ , where the values of  $d_{201}$  and  $d_{112}$  decrease sharply with increase in  $\sigma$ ; and  $\sigma > 65 \text{ kg/mm}^2$ , where the values of  $d$  increase with the load. Apparently, in this region the true relationships are described by the dashed curve, since the transverse dimensions of the specimens are increased and in order to maintain the stress, one has to provide additional loading