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FROM HYDROEXTRUSION TO BAROCRYODEFORMATION

A distinctive feature of hydroextrusion, which is widely used today to improve the properties and deformation of metals and alloys, is that prior to deformation, the material is subjected to uniform compression, at which the subsequent deformation occurs. Both traditional hydroextrusion and new extrusion-based methods of metal processing can not be used at cryogenic temperatures. At the same time, at deep cooling, when processes of dynamic recovery are depressed, we can expect maximum possible concentration of defects and related high density of interfaces. In the present work, schemes similar to hydroextrusion are described, where the deformable object is also compressed prior to beginning of deformation, but these conditions are realized at cryogenic temperatures. The presented results of such exposure of some metals and alloys indicate the possibility of increase in their thermal stability by lowering of the temperature of deformation. Ultrafine structure, which provides high mechanical properties, can be obtained at low degrees of deformation. The defect structures of high regularity were obtained, which are not observed in other types of deformation. The conclusion on the expediency of expanding the researches in this direction has been made.

Keywords: hydroextrusion, uniform, compression, barocryodeformation, cryogenic temperatures, metals, strength, ductility

Fig. 1. Schemes of hydroextrusion: *а* – general case of hydroextrusion, *б* – special case of hydroextrusion

Fig. 2. Different conditions of material deformation

Fig. 3. The structure of polycrystalline copper rolled at 300 (*а*), 77 (*б*) and 20.4 K (*в*) [19]

Fig. 4. The structure of polycrystalline copper, deformed by quasihydroextrusion at 300 (*а*), 190 (*б*), 125 (*в*), 77 (*г*) and 20.4 K (*д*) [20]

Fig. 5. The structure of polycrystalline copper, deformed by quasihydroextrusion at 77 K to 60% and then deformed by tension at room temperature until a neck [21]: *а* – in the neck zone, *б* – far from the neck

Fig. 6. Dependence of the limiting plasticity at break ε under hydrostatic pressure *P*

Fig. 7. Barocryodeformation of steel st50 at 77 K: *а* – special case, hardening 10–15%; *б* – general case (backpressure ~ 3 kbar), hardening 50–70% without discontinuities

Fig. 8. Barocryodeformation of Hf at 77 K: *а* – special case; *б* – general case (backpressure ~ 6 kbar)