FEATURES OF HIGH-RATE PLASTIC DEFORMATION OF IRON UNDER EXPLOSIVE LOADING IN SPHERICAL SYSTEMS

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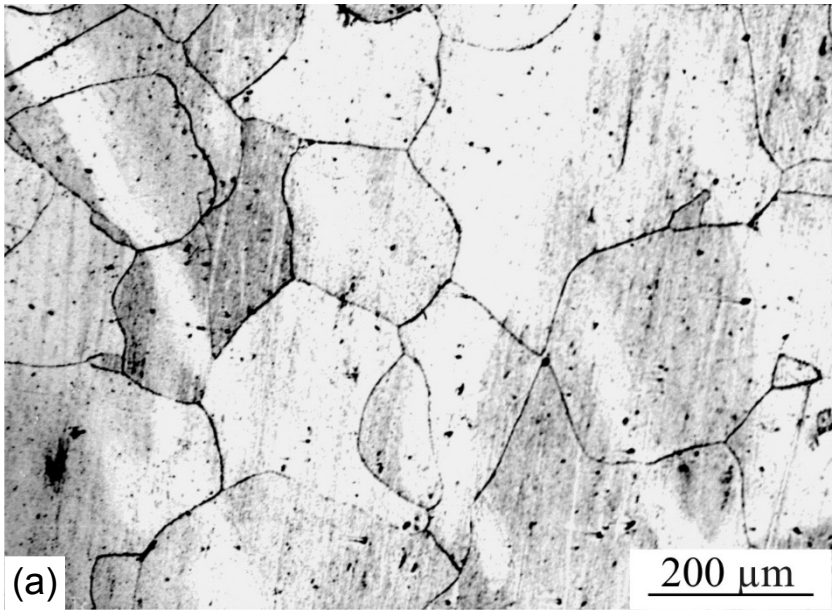
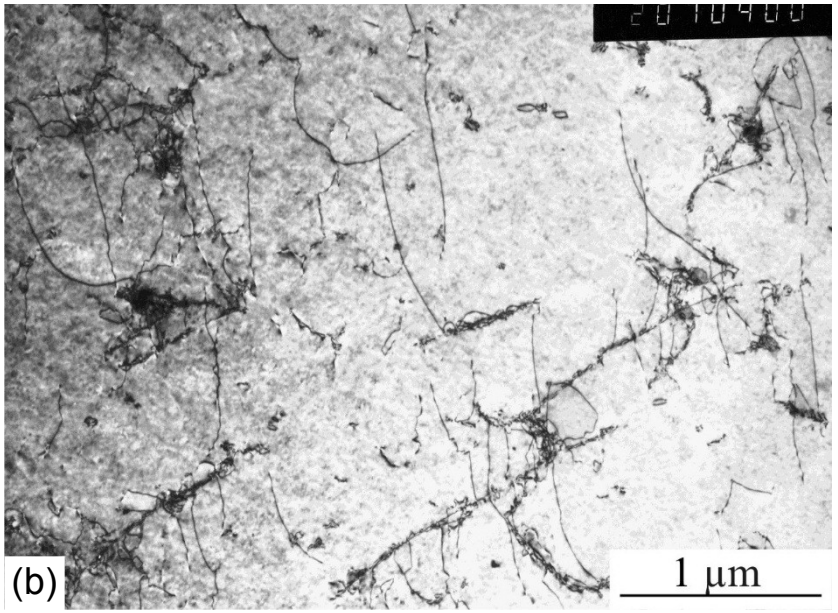
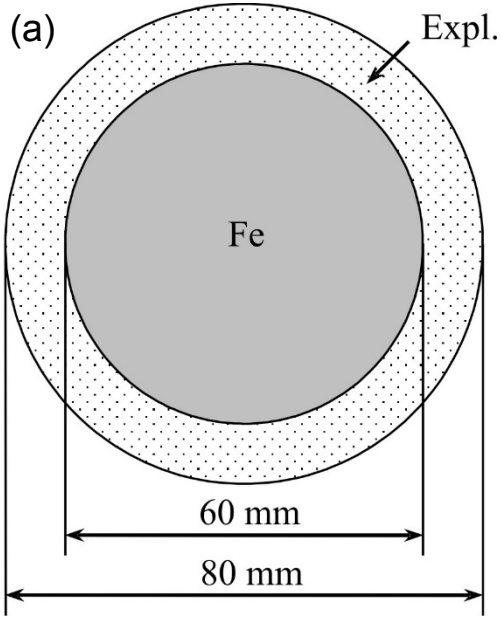
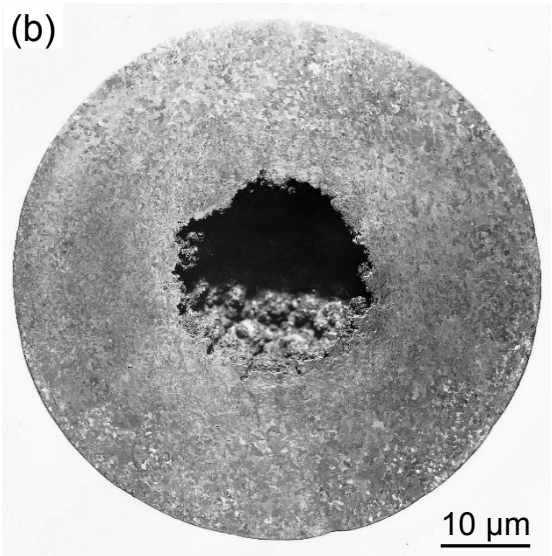
(a) Structure and (b) microstructure of iron in the initial state

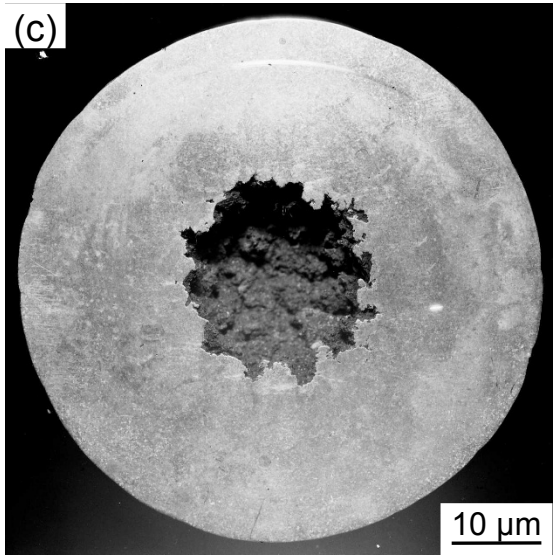




(a) Scheme of loading and (b, c) the appearance of the meridional sections of the samples after explosive loading

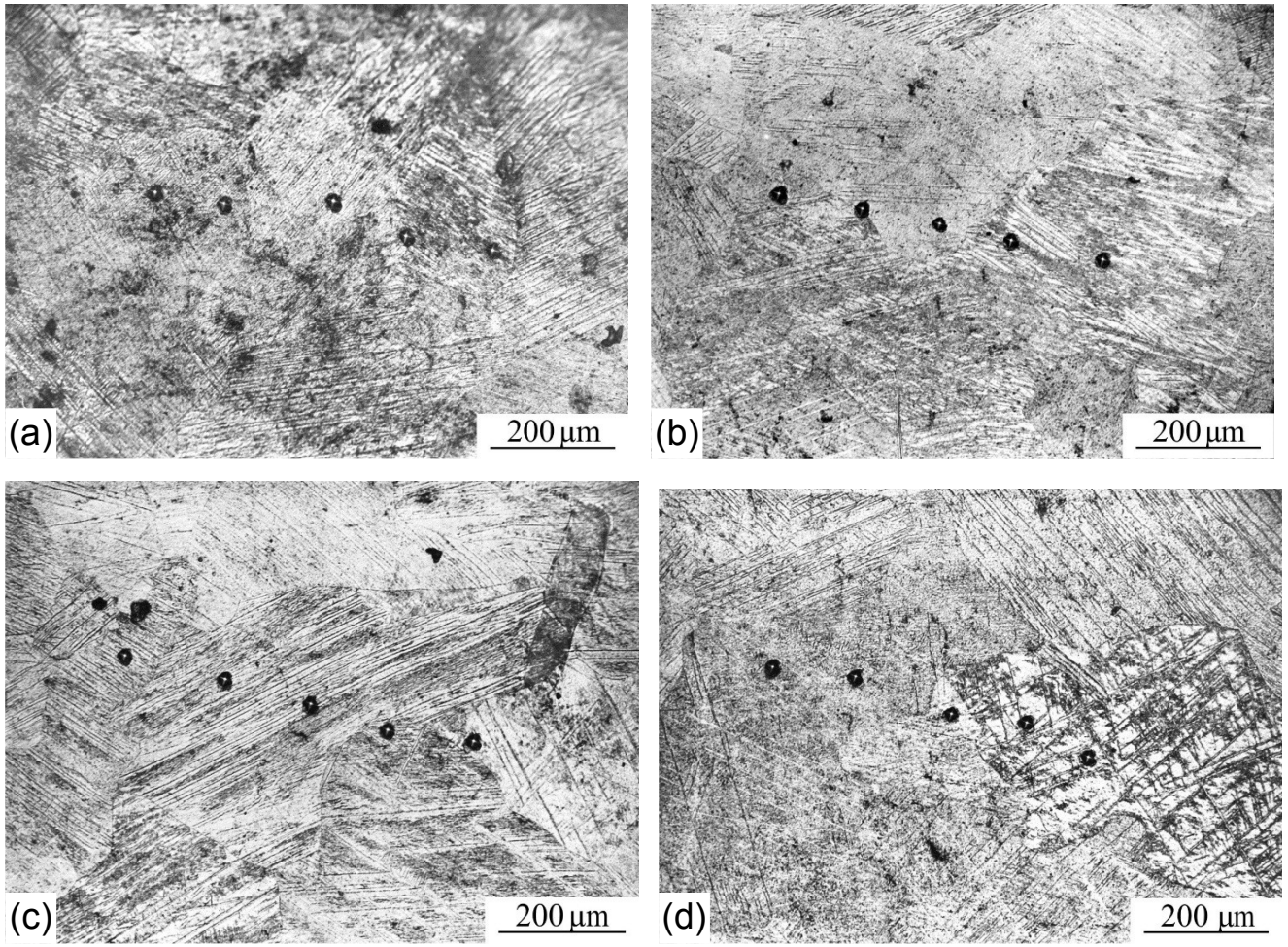






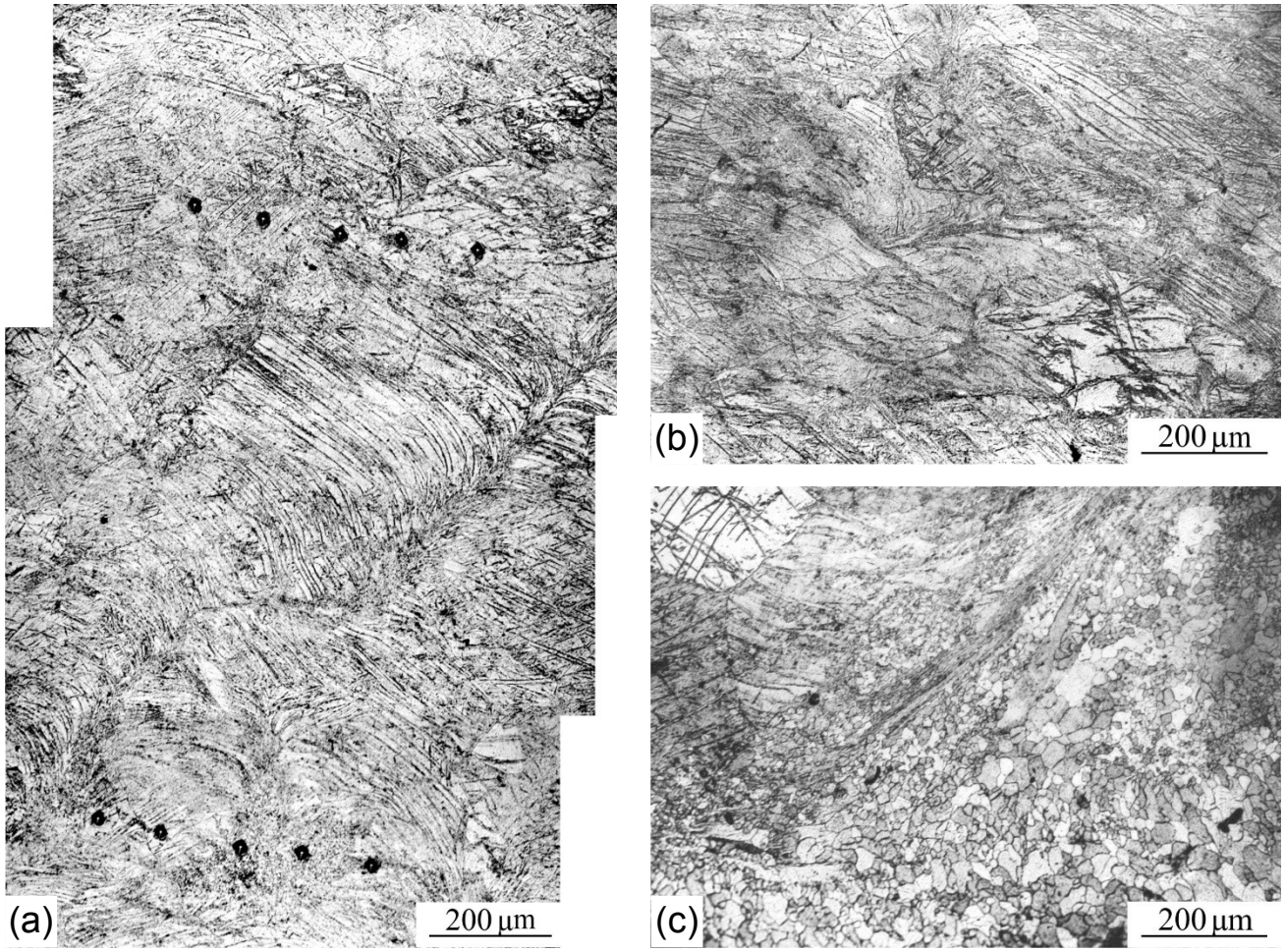
(b) – high-purity iron; (c) – Armco iron.

Structure of high-purity iron at various distances from the ball surface



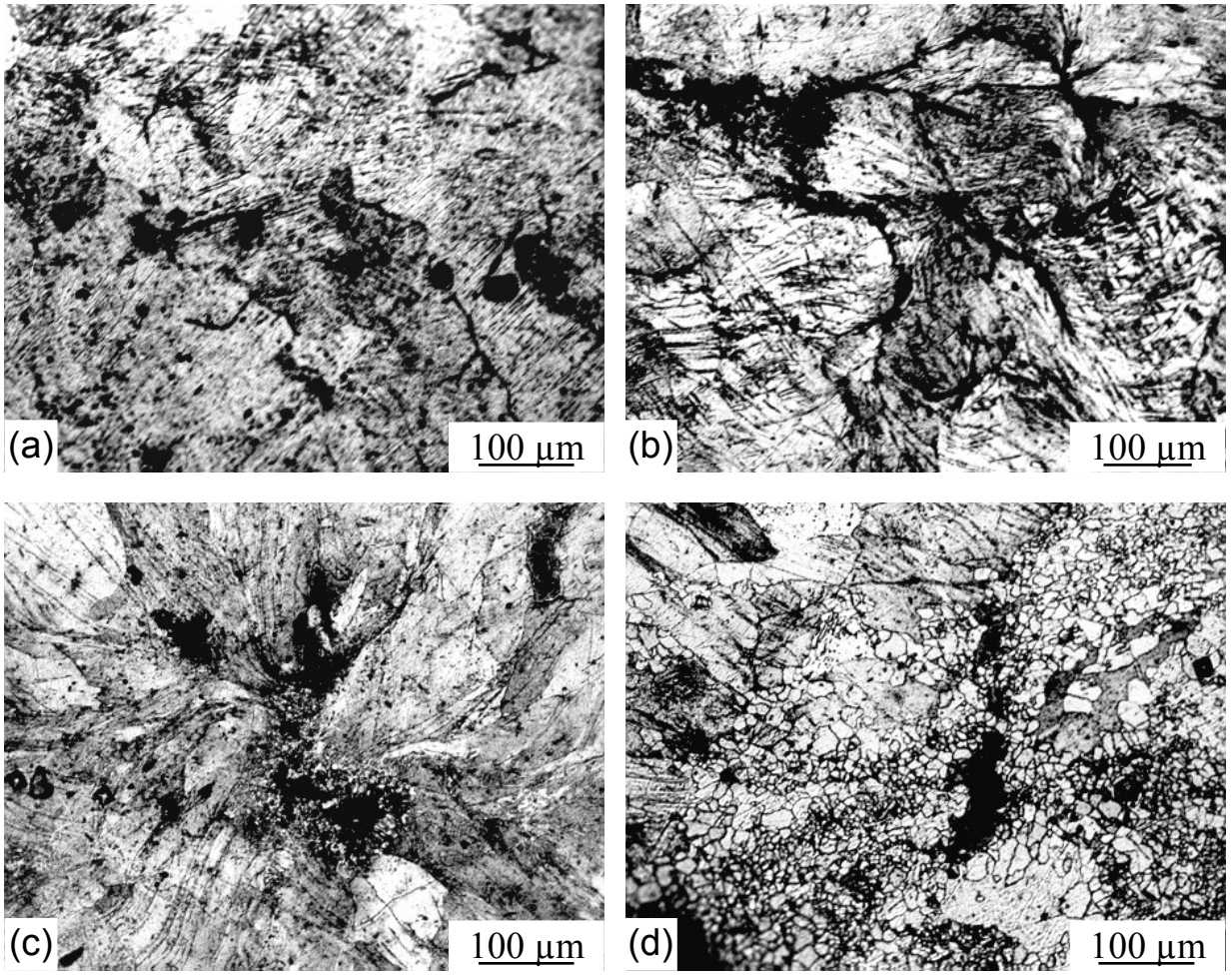
(a) 1 mm; (b) 3 mm; (c) 7mm; (d) 10 mm.

Structure of high-purity iron at various distances from the ball surface



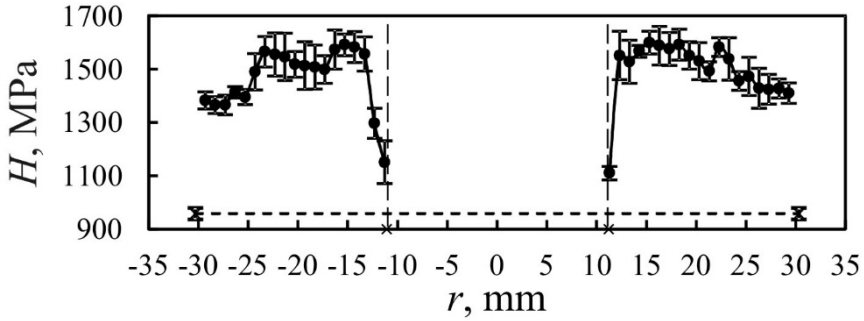
(a) 13-14 mm; (b) 14.5 mm; (c) 18.5 mm.

Structure of Armco iron at various distances from the ball surface

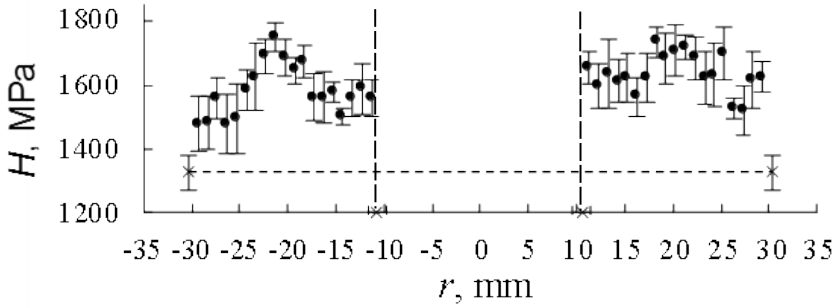


(a) 1 mm; (b) 14.8 mm; (c) 19 mm; (d) 20.2 mm.

Change in microhardness of samples along radial direction



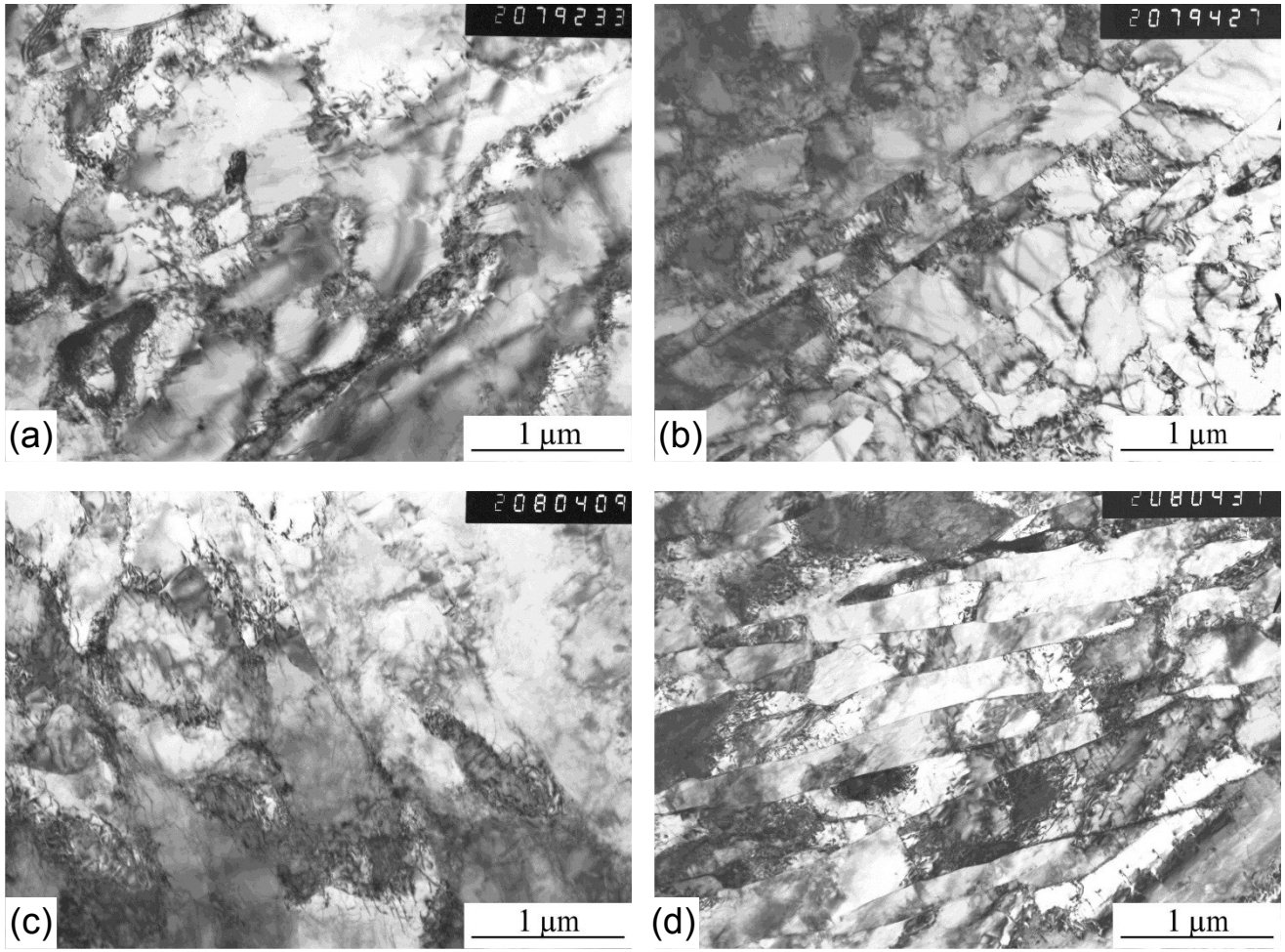
(a)



(b)

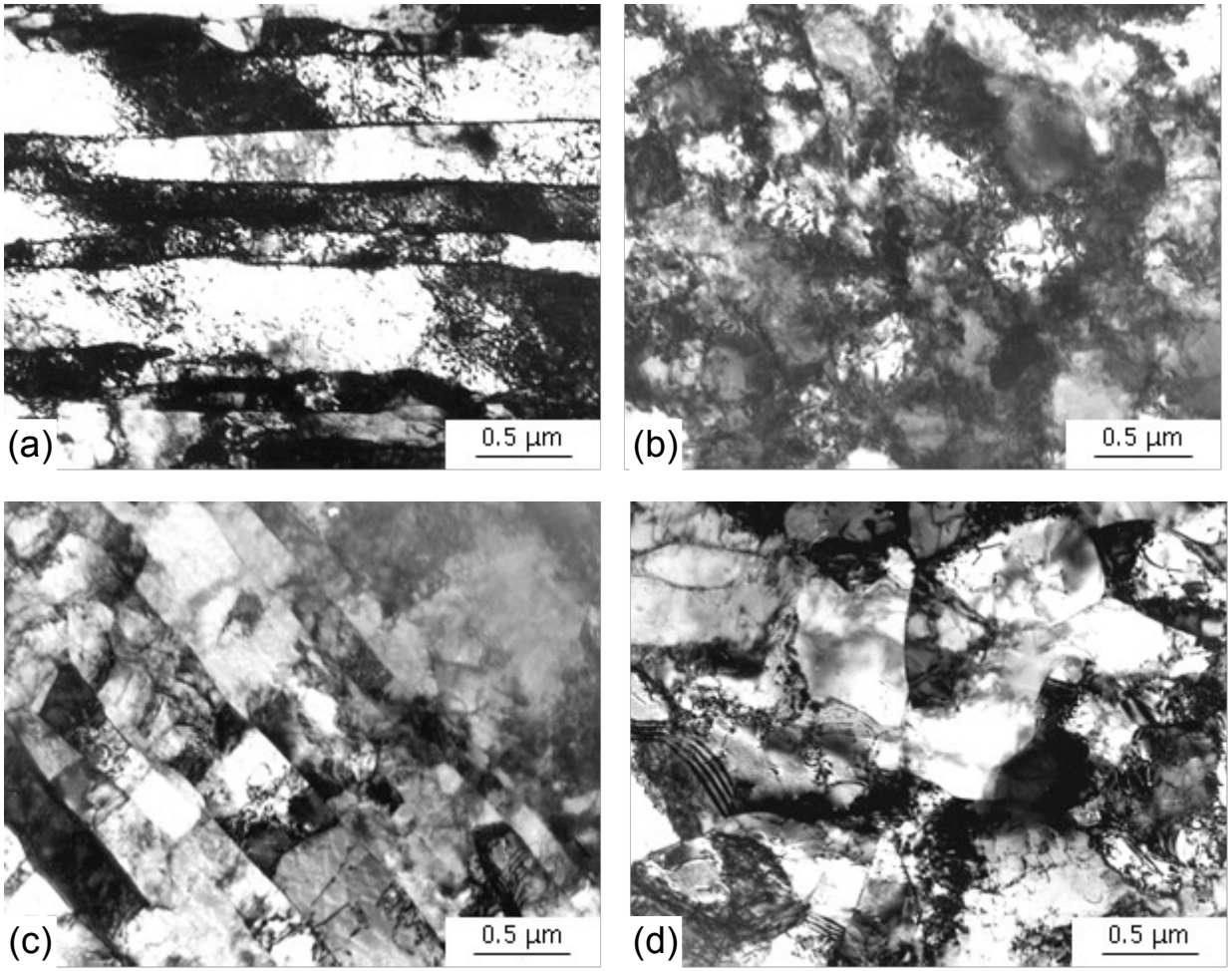
(a) high-purity iron; (b) Armco iron.
Vertical dashed lines correspond to boundary of inner cavity.
Horizontal dashed lines correspond to microhardness in initial state.

Microstructure of high-purity iron at various distances from the ball surface



(a) 5.2 mm; (b) 10.8 mm; (c) 13.6 mm; (d) 16.4 mm.

Microstructure of Armco iron at various distances from the ball surface



(a) 5.1 mm; (b) 7.9 mm; (c) 14 mm; (d) 16.8 mm.

CONCLUSIONS

High-rate plastic deformation of iron proceeds by slip in these loading conditions. Localization of deformation occurs in the process of loading, leading to the formation of shear bands inside the initial grains, and also to the formation of localized deformation bands along the grain boundaries in deep layers of spherical samples. High-rate plastic deformation of iron at realized regimes loading proceeds in the ε-phase therefore twins aren't formed.

The difference in the deformation behavior of high-purity iron and Armco iron can be due to the fact that dislocations are more mobile in high-purity iron, since Cotrella clouds do not form near them. Therefore, the dislocation density in Armco iron can be larger by an order of magnitude for equal degrees of deformation. The lesser mobility of dislocations in Armco iron cannot provide relaxation of the acting stresses, which leads, in particular, to the formation of cracks inside the deformation localization bands.

Thank you for attention!