Impact tests with profiled copper cylinders: experiment and microstructural analysis

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A modification of Taylor's tests for the impact of a rod on an anvil was realized for the case of copper profiled cylinders. A cylinder with a diameter of 8 mm and a length of 40 mm was chosen for the classic Taylor test, and was also cut from a cold-drawn copper rod made of oxygen-free M1 copper and machined in the head part to obtain three different shapes: 1) a reduced cylinder with a diameter of 3 mm and a length of 10 mm; 2) the same reduced cylinder with a diameter of 4 mm; 3) a truncated cone with a top diameter of 2 mm and a length of 20 mm. The samples were launched with a gas cannon at speeds up to 125 m / s and collided with a rigid stainless steel anvil. In the experiments, the valuesof the true strain of the order of 0.5—1 and the strain rate up to 2.4 10^4 s^{-1} were realized. Microstructural analysis of deformed and undeformed samples was carried out. Undeformed samples are characterized by a longitudinal texture with localization bands (up to 20 m wide) formed during the production of cold-rolled bars, the average grain diameter is 18.5 m. At high magnification (1000x), a subgrain mesh structure with the size of subgrain up to 3 m is clearly visualized. The deformed sample is characterized by the presence of cracks at the transition from the head of the reduced diameter to the main part of the cylinder. The cylinders used in the classical Taylor test are also characterized by the presence of spherical cavities with an average diameter of 15-30 m near the impact boundary. This work is supported by the Russian Science Foundation (project No. 20-79-10229).