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The combined effects of grain and sample sizes on the mechanical properties and fracture modes of gold microwires

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Hall-Petch relation was widely applied to evaluate the grain size effect on mechanical properties of metallic material. However, the sample size effect on the Hall-Petch relation was always ignored. In the present study, the mechanical test and microstructure observation were performed to investigate the combined effects of grain and sample sizes on the deformation behaviors of gold microwires. The polycrystalline gold microwires with diameter of 16 μm were annealed at temperatures from 100°C to 600°C, leading to different ratios (t/d) of wire diameter (t) to grain size (d) from 0.9 to 16.7. When the t/d was lower than 10, the yield stress dropped fast and deviated from the Hall-Petch relation. The free-surface grains played key role in the yield stress softening, and the volume fraction of free-surface grains increased with the t/d

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