HIGH STRAIN RATES MICROMECHANICAL BEHAVIOR OF MATERIALS: A COUPLED EXPERIMENTAL AND NUMERICAL APPROACH

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Recent developments in the field of micromechanics allowed the identification of mechanical behavior of materials at high strain rate. In this work, a high strain rates device and a micropillar compression up to 500s-1 testing procedure is presented. In the same time, 3D discrete dislocation dynamics simulation [2] is set-up for strain rates similar to experimental ones. An application is made on copper single crystals micropillars machined by FIB. The coupling of these two approaches allowed a better understanding of inertial effects and size effects at high strain rates.

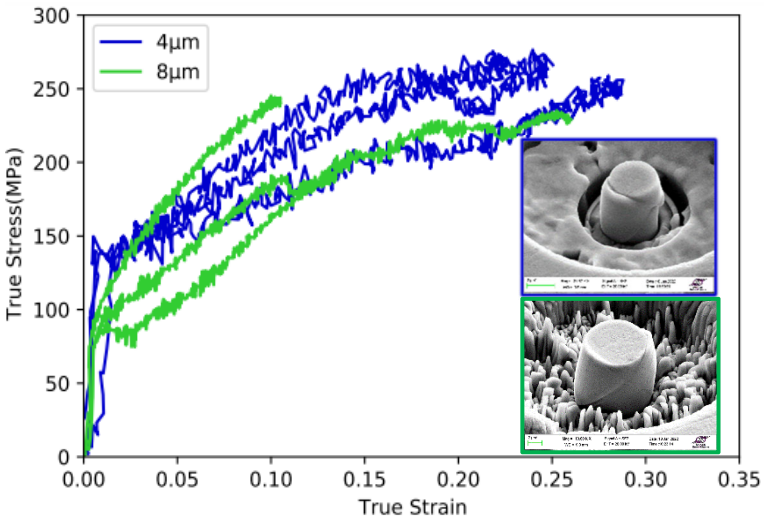

Figure 1 – High strain rates micropillar compression on Copper [001]

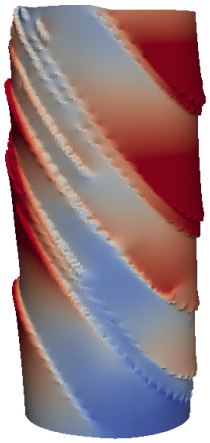

Figure 2 – 3D Discrete dislocation dynamics simulation of micropillar compression

[1] G. Guillonneau, M. Mieszala, et al. J. Wehrs , J. Schwiedrzik , S. Grop, D. Frey, L. Philippe, J-M Breguet, J. Michler, J. Wheeler, Nanomechanical testing at high strain rates: New instrumentation for nanoindentation and microcompression, Materials and Design, 148, pp. 39-48, (2018).

[2] G.S. Kim, M.C. Fivel, H.J. Lee, C.S. Shin, H.N. Han, H.J. Chang et K.H. Oh, A discrete dislocation dynamics modelling for thermal fatigue of preferred oriented copper via patterns, Scripta Materialia, 63, pp. 788-791, (2010).