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The effect of size and temperature on the deformation of cast silver microwires

Luciano Borasi[a]; Simone Frasca[b]; Edoardo Charbon[b]; Andreas Mortensen[a]

[a] *Laboratory of Mechanical Metallurgy (LMM), STI, IMX, École Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland*

[b] *Advanced Quantum Architecture Laboratory (AQUA), STI, IMT, École Polytechnique Fédérale de Lausanne (EPFL), CH-2002 Neuchâtel, Switzerland*

[a] *luciano.borasi@epfl.ch*

In the present study silver microwires are produced by means of a novel casting process that combines silicon microfabrication techniques for precise mold production and molten silver pressure infiltration followed by solidification and mold leaching. In each resulting casting a large number of monocrystalline silver wires are obtained, with diameters in the range from 15 μm to 2.5 μm, an aspect ratio greater than 5, and a shape that makes the silver wires suited for in-situ SEM tensile testing. Their deformation behavior depends strongly on crystal orientation and size. The microwires display a large number of stochastically distributed load drops which are analyzed by means of the complementary cumulative distribution function. Room temperature results are contrasted with bulk counterparts that have a diameter in the millimeter range and are cast by a similar infiltration-based method. The effect of temperature on deformation, yield, intermittency and strain hardening is also explored by performing in-situ tests on microwires at 200 °C and 400 °C. Comparison with the behavior of similar structures made of aluminium highlights the role played by the stacking fault energy on microscale FCC metal deformation.

Keywords: silver, size-effect, yield, intermittency, work hardening.

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