# SIZE EFFECTS IN TENSILE TESTING OF THIN COPPER FOILS

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A common trend in modern technology is the miniaturization of many devices to save weight and space, to reduce the use of natural resources and energy and to lower costs. A lot of new devices are now being built up with typical dimensions of several tens micrometers. As for large structures the mechanical integrity of small devices is of utmost importance. For a reliable design the knowledge of the mechanical properties of the materials used is required. The mechanical properties of a material are known to depend strongly on its microstructure (e.g. in crystalline materials the grain size) whereas the influence of the sample's size on the material behavior ("size effect") is still an object of current research. Although the theoretical modeling of size effects is rather advanced (e.g. strain gradient plasticity) most of these models base on a few experimental results where the importance of the microstructure was often not analyzed sufficiently.

This study tries to close this gap for thin copper foils by performing a thorough characterization of microstructure before and after loading. The samples tested were thin rolled copper foils with a thickness varying from 10 to 250 microns. Tensile test samples ("dog bone" shape) were fabricated by photolithography and wet etching.
For the determination of the microstructure several methods were applied which had to be adjusted for the small sample size. The texture of the samples was measured by X-ray diffraction (macrotexture) and electron backscatter diffraction (microtexture). The latter together with metallography was used for analyzing the grain structure. The loading of the samples was performed in a self built tensile test machine.

A pronounced effect of the thickness of thin copper foils is found in tensile testing under constant strain rate: The thinner a foil the smaller is the fracture strain. Foils which are thinner than 20 microns show macroscopically hardly any plastic deformation whereas the 250 microns thick foils still show the typical behavior of bulk copper.