In-Situ TEM Deformation of Free-Standing Thin Films and Molecular Dynamics Simulations

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Abstract. Mechanical properties of nanocrystalline films have been found to differ from typical features exhibited in bulk coarse grained materials. To gain insight for the casuses of higher yield and tensile strength and lower ductility measured in these films, experiments allowing direct observations of the deformation mechanisms such as in-situ transmission electron microscopy tensile testing as well as molecular dynamics computer simulations can be employed. A restricted time and size scale of molecular dynamics simulations results in simulations using strain rates several orders higher than strain rates and sample sizes smaller that generally used in real deformation experiments. In-situ tensile experiments of free-standing 50 nm thick nanocrystalline Al films have been realized and results were compared with the molecular dynamic simulation designed to approach the conditions of performed experiment in a reasonable computational time.