Acquisition of Nanomechanical Instrumentation

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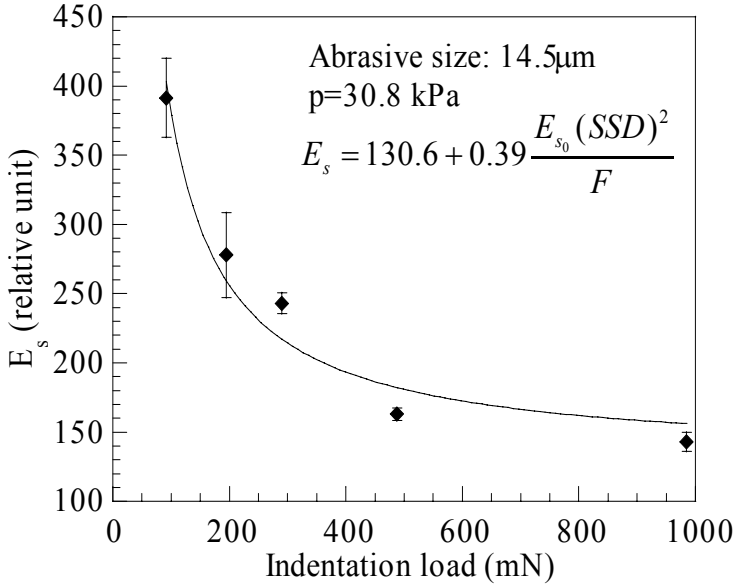
A new tool for the characterization of surface damage in ground silicon wafers. Grinding as one of the important processes for silicon manufacturing industry is the first step to reduce the cutting-caused surface-damage, which is one of key parameters determining the surface quality of the silicon wafers. To understand the evolution of surface damage in grinding process, a new approach supported by NSF, Acquisition of Nanomechanical Instrumentation, was developed. In the approach, indentation was used to evaluate the near-surface elastic behavior of ground silicon wafers. The right figure shows the effect of indentation load on the nominal contact modulus of ground silicon wafers. The nominal near-surface contact modulus decreases with indentation load – the ground surfaces experience softening behavior due to the propagation and formation of subsurface damage.



Surface degradation in the indentation
E_S: nominal contact modulus
SSD: subsurface damage
E_{s_0}: Young's modulus of damage free silicon wafers

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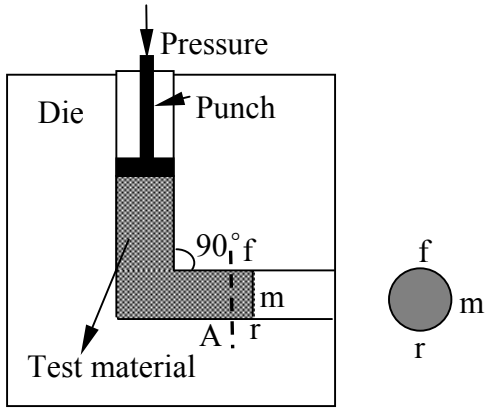
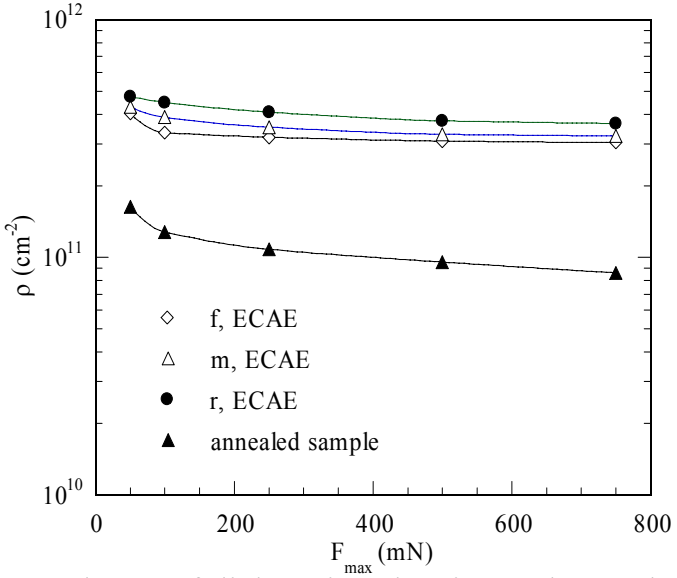
Indentation of aluminum processed by equal channel angular extrusion. The understanding of micromechanical behavior of severe deformed materials is important for the application of ultra fine-grained structural materials formed by the equal-channel-angular extrusion process. In work supported by NSF, Acquisition of Nanomechanical Instrumentation, indentation was used to determine the near-surface deformation of the ECAE deformed aluminum at three different locations in the cross-section of the sample. The contact stiffness of the ECAE deformed Al obtained from the unloading curves is less than that of the annealed samples, which suggests the change of microstructure created by the ECAE process. Work-hardening phenomenon was observed in the tests, which depends on the position of the samples. Highest work hardening occurred at the location r, which was subject to compression-tension-compression loading sequence. For the location f subject to only compression, it has the lowest work hardening.



Schematic diagram of the ECAE process



Dependence of dislocation density underneath the indenter on the indentation load