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Lab on-chip for testing thin film materials: extraction of mechanical properties at the nanometer scale

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Content

Thin films constitute the building blocks of a large number of modern technologies including protective coatings, microelectronic devices, bio-responsive membranes and photovoltaic cells. These nanolayers exhibit vastly different mechanical properties from their bulk counterpart. New measurement techniques are therefore required to accurately and reliably measure the mechanical properties of thin films.

At UCL, a simple lab-on-chip concept has been created to assess the mechanical properties of submicron freestanding thin films. It relies on the use of internal stresses generated in an “actuator layer” to apply a deformation to a “specimen layer” attached to it owing to the release of an underneath “sacrificial layer”. The simplest test structure configuration gives access to one point of the stress - strain curve of the specimen material while photolithography enables to reproduce this elementary tensile test structure thousands of times to generate the full stress – strain behaviour up to fracture.

This simple idea gives access to several extensions including different loading configurations, relaxation tests, TEM observation of deformation mechanisms and piezoresistance measurements.

This lab-on-chip concept has already proven to be suitable for extraction of mechanical properties of ductile materials (Pd, AlSi, Ni, Cu, Pt, etc.) as well as brittle materials (monocrystalline Si, polycrystalline Si, oxides, nitrides, metallic glasses). The piezoresistance of silicon nanowires under high tensile stress has also been assessed through this technique.

Poster contest (if applicable)

No

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