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A simple microtensometer for polymeric micro-parts

M-C Sun, D G Chetwynd* & J W Gardner

School of Engineering
University of Warwick
Coventry CV4 7AL, U.K.

Growing interest in polymers for micromechanical systems reflects their great technological potential, but its realization requires much better knowledge of their mechanical properties than now exists. Tests need to be performed on appropriately small specimens, since surface effects will be more critical than at larger scales. Unfortunately, such tests require measurement of very small forces and extremely small displacements in order to obtain reasonable resolution of strain.

In this paper, we describe the design and characterization of a novel, simple test-rig – a microtensometer – aimed specifically at such applications. It can operate in compression as well as in tension mode (and so could also be applied to bending, peel, *etc*.). It is based on imposing displacements of up to 10 μm by a PZT actuator operating against an interchangeable linear flexure mechanism acting as the force generator. The sample is mounted between the actuator and spring, the deflections of which are monitored by capacitive micrometry to a precision of a few nm. One major challenge of testing tiny specimens is that of protecting them from damage while attaching and aligning them to the test-rig. The technique used here involves a supporting frame of small printed circuit boards connected by solder bridges that can later be gently melted out.

After a brief review of the concept, there is more detail of some critical features of the microtensometer. The paper then goes on to discuss characterization and calibration, demonstrating the range and sensitivity obtained. While this paper is not concerned directly with materials properties, the potential of the microtensometer is illustrated by its application to electro-polymerized poly(pyrrole) samples 10 to 20 μm long and having unusual mechanical properties.

*Email: D.G.Chetwynd@warwick.ac.uk
For Chetwynd, direct telephone +44 (0)24 7652 3121, fax +44 (0)24 7641 8922