Engineering Conferences International
ECI Digital Archives

Nanomechanical Testing in Materials Research and Development V

Proceedings

Fall 10-5-2015

Environmentally controlled modulus mapping of biocomposite materials employing the concept of effective mass

Bernd Bayerlein
Max Planck Institute of Colloids and Interfaces, bernd.bayerlein@mpikg.mpg.de

Igor Zlotnikov
Max Planck Institute of Colloids and Interfaces

Recommended Citation

[1] L. Bertinetti, U. D. Hangen, M. Eder, P. Leibner, P. Fratzl and I. Zlotnikov, "Characterizing moisture-dependent mechanical properties of organic materials: humidity controlled static and dynamic nanoindentation of wood cell walls", Phil. Mag. doi: 10.1080/14786435.2014.920544 (2014). [2] I. Zlotnikov, P. Fratzl and E. Zolotoyabko, "Nanoscale elastic modulus mapping revisited: The concept of effective mass", J. Appl. Phys. 116 (11), 114308 (2014).

ENVIRONMENTALLY CONTROLLED MODULUS MAPPING OF BIOCOMPOSITE MATERIALS EMPLOYING THE CONCEPT OF EFFECTIVE MASS

Bernd Bayerlein, Max Planck Institute of Colloids and Interfaces, 14476 Potsdam, Germany
Bernd.Bayerlein@mpikg.mpg.de
Igor Zlotnikov, Max Planck Institute of Colloids and Interfaces, 14476 Potsdam, Germany

Living organisms are known to form a large variety of mineral-organic composite structures with mechanical properties that combine high stiffness, strength, toughness and perform at different levels of relative humidity (RH). Usually, the organic components are spatially limited to sub-micrometer features and are confined by a much stiffer mineral material. Mechanical characterization of these organic features, whose properties are strongly influenced by RH, presents a real technical challenge. In the present work we demonstrate our ability to measure environmentally dependent static and dynamic mechanical performance of 1 µm thick organic films in the prismatic layer of the mollusc shell *Pinna nobilis* employing the nanoscale modulus mapping technique. Two recent developments were utilized during the mechanical characterization process: (1) Environmental control during measurements enabled us to perform the modulus mapping in RH ranging from 0 to 98% [1]; (2) The concept of effective mass of the nanoindenter tip/sample configuration enabled us to account for drastic changes in elastic properties of the organic phase with increasing RH [2]. The possibilities and the limitations of this methodology with regards to structural and mechanical properties of the studied prismatic microstructure in the shell will be discussed.

[1] L. Bertinetti, U. D. Hangen, M. Eder, P. Leibner, P. Fratzl and I. Zlotnikov, “Characterizing moisture-dependent mechanical properties of organic materials: humidity controlled static and dynamic nanoindentation of wood cell walls”, Phil. Mag. doi: 10.1080/14786435.2014.920544 (2014).
[2] I. Zlotnikov, P. Fratzl and E. Zolotoyabko, “Nanoscale elastic modulus mapping revisited: The concept of effective mass”, J. Appl. Phys. 116 (11), 114308 (2014).