PHD DISSERTATION DEFENSE

MS. QIAN CHEN

Advisor: Dr. Virginia Ayres
Department of Electrical & Computer Engineering
Michigan State University

Monday, December 10, 2007

1:00 – 3:00 PM
2219 Engineering Building
(ECE Conference Room)

"SCANNING PROBE RECOGNITION MICROSCOPY: RECOGNITION STRATEGIES"

ABSTRACT

Scanning Probe Recognition Microscopy (SPRM) is a specially modified Scanning Probe Microscopy (SPM) system designed and developed by our research group in partnership with Veeco Instruments. In Scanning Probe Recognition Microscopy, the SPM system itself is given the ability to automatically track regions of interest during scanning through incorporation of recognition–based tip control. The recognition capability is realized by using algorithms and techniques in image processing, pattern recognition and computer vision fields. Adaptive learning and prediction are also implemented to make the object detection and tracking procedures quicker and more reliable. The major contribution of SPRM includes: (1) decreasing overall operation time; (2) providing the ability to quantitatively measuring properties while maintaining the uniformity of experimental environment; (3) sequentially measuring topographic, mechanical and chemistry properties of the same sample surface through repetitive high resolution scanning in the appropriate mode; (4) properties measuring in situations which are inaccessible by standard SPM. SPRM measurements of the surface roughness, elasticity and surface chemistry of 2D nanoscale electrospun carbon nanofibers are given in detail as an example of SPREM analysis in a situation that is not fully accessible by SPM. The 3D nanoscale electrospun nanofibers are the components of a tissue scaffold for regenerative medicine. These scaffolds are used for neural cells re-growth in a damaged spinal cord. The candidate's thesis research is therefore to design and implement the recognition strategies that allow SPRM properties extraction along tissue scaffold nanofibers, to perform the first quantitative measure of multiple properties that have been shown to be important in neural cell re-growth and, by doing so, to contribute significant understanding to the cure of presently incurable paralysis.

Publications:

1] Q. Chen, Y. Fan, L. Udpa, and V. M. Ayres, "Cell Classification by Moments Based Methods with Continuous Wavelet Transform," Vol. 2, Issue 2, pp. 181-189 Int. J. Nanomedicine (2007).

2] Y. Fan, Q. Chen, V.M. Ayres, A.D. Baczewski, L. Udpa and S. Kumar, "Scanning Probe Recognition Microscopy Investigation of Tissue Scaffold Properties," in press, Vol. 2, Issue 4, Int. J. Nanomedicine (2007).

3] Q. Chen, Y. Fan, S. Kumar, A.D. Baczewski, L. Udpa, V.M. Ayres, A. F. Rice, S. Meiners and I. Ahmed, "Cell Response and Tissue Scaffold Triggers Investigated by Scanning Probe Recognition Microscopy," in Engineered Nanoscale Materials for the Diagnosis and Treatment of Disease, edited by V.A. Hackley, A.K. Patri, J. Stein, B.M. Moudgil (Mater. Res. Soc. Symp. Proc. Volume 1019E, Warrendale, PA, 2007), 1019-FF06-04

4] Y. Fan, Q. Chen, S. Kumar, A.D. Baczewski, L. Udpa, V.M. Ayres and A. F. Rice, "Scanning Probe Recognition Microscopy Investigation of Nanoscale Mechanical and Surface Roughness Properties Along Nanofibers," in Surface and Interfacial Nanomechanics, edited by R.F. Cook, W. Ducker, I. Szlufarska, R.F. Antrim (Mater. Res. Soc. Symp. Proc. Volume 1021E, Warrendale, PA, 2007), 1021-HH05-26.

5] (Invited) L. Udpa, V. M. Ayres, Y. Fan, Q. Chen and S. Arun-Kumar, "Deconvolution of Atomic Force Microscopy Data for Cellular and Molecular Imaging," IEEE Sig. Proc. Mag., Special Issue on Molecular and Cellular Bioimaging, Vol. 23, No. 3, pp. 73-83 (2006).

6] S.L. Rutledge, H.C. Shaw, L.L. Yowell, Q. Chen, B.W. Jacobs, S.P. Song and V.M. Ayres, "Self Assembly and Correlated Properties of Electrospun Carbon Nanofibers", Diamond and Relat. Mater., Vol. 15, pp. 1070-1074 (2006).

7] Y. Fan, Q. Chen, S. A. Kumar A.D. Baczewski, N.V. Tram, V.M. Ayres, A.F. Rice, L. Udpa, “Registration of Tapping and Contact Mode Atomic Force Microscopy Images”, 2006 6th IEEE Conference on Nanotechnology Proceedings, ISBN 1-4244-0078-3.

8] Q. Chen, Y. Fan, V.M. Ayres, L. Udpa, M.S. Schindler and A. F. Rice, "Scanning Probe Recognition Microscopy Investigation of the Elastic Properties of Tissue Scaffolding", in Mater. Res. Soc. Symp. Proc. Vol. 838E: Scanning-Probe and Other Novel Microscopies of Local Phenomena in Nanostructured Materials, edited by S.V. Kalinin, B. Goldberg, L.M. Eng, and B.D. Huey, The Materials Research Society, Warrendale, PA (2005), O15.2, Electronic: ISBN 1-55899-802-0.

9] Q. Chen, L. Udpa, M. S. Schindler, C. Berger and V. M. Ayres, "Scanning Probe Recognition Microscopy Investigation of Cells on Scaffolding", Mat. Res. Soc. Symp. Proc. Vol. EXS-1: Architecture and Applications of Biomaterials and Biomolecular Materials, Eds. Joyce Y. Wong, Anne L. Plant, Christine E. Schmidt, Lonnie Shea, Arthur J. Coury, Christopher S. Chen, 2004, The Materials Research Society, Warrendale, PA (2004), pp. 143-145., Hardbound: ISBN 1-55899-745-8.

10] Q. Chen, Y. Fan, L. Udpa, M.S. Schindler and V.M. Ayres, "Scanning Probe Recognition Microscopy for Nano Biomedical Applications", Proceedings of the 5th Trends In Nanotechnology (TNT04) CMP Cientifica, (2004).

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12] Q. Chen, Virginia Ayres, and Lalita Udpa, "Biological Investigation Using Scanning Probe Recognition Microscopy", Proceedings of the 3rd IEEE Conference on Nanotechnology (IEEE-Nano 2003), Vol. 2, pp. 863-865 (2003).