

Detection of Long Chain Bio-Polymers using Atomic Force Microscopy

Mark S. Anderson

Analytical Chemistry and Materials Research Group

Jet Propulsion Laboratory, MS 125-112

California Institute of Technology

4800 Oak Grove Drive

Pasadena CA, 91109.

Email: mark.s.anderson@jpl.nasa.gov

Phone 818-354-3278

Abstract:

The Atomic Force Microscope (AFM) is demonstrated as a detector for long chain polymers and soft organics on mineral surfaces. Long chain (linear) polymers have been proposed as a general bio-markers [1-3]. The AFM provides very sensitive detection of polymeric strands using the force spectroscopy mode of operation [4]. In this mode, the force is measured as the AFM tip makes intermittent contact with a polymeric sample. As polymer strands are pulled from the surface onto the AFM tip, a characteristic detachment signal is measured in the force-distance plot.

AFM force spectroscopy provides polymer length, folding information and is capable detecting single molecules. AFM force spectroscopy of synthetic proteins, fossils surfaces and algae on mineral surfaces are presented as test examples.

AFM instruments have flown on two space missions, the Phoenix MECA experiment and the Rosetta MIDAS experiment [5,6]. In addition to providing high resolution imaging, this work demonstrates a powerful new application of the AFM that is relevant to astrobiology missions.

References:

1. Lovelock J. E., "A Physical Basis for Life Detection Experiments", *Nature*, Vol. 207, Issue: 4997, Published 1965.

2. Westall F., Steele A., Toporski J., et al. "Polymeric substances and biofilms as biomarkers in terrestrial materials: Implications for extraterrestrial samples" *Journal of Geophysical Research-Planets*, Vol., Issue: E10, OCT 25 2000.

3. D. Dreamer "First Life" University of California Press, 2011.

4. Hugel T., Seitz M., "The Study of Molecular Interactions by AFM Force Spectroscopy" *Macromolecular Rapid Communications* Volume 22, Issue 13, pages 989–1016, September 2001.

5. Sykulska, H.; Pike, W. T.; Stauffer, U.; Parrat, D.; Goetz, W.; Vijendran, S.; Morookian, J.-M.; Hecht, M. "An Overview of OM and AFM Data Acquisition by the MECA Instrument on Phoenix", Workshop on the Microstructure of the Martian Surface, held August 27-29, 2009 in University of Copenhagen, Denmark. LPI Contribution No. 1505, p.21-22

6. Bartha W., et al., "Evaluation and fabrication of AFM array for ESA-Midas/Rosetta space mission", *Microelectronic Engineering* Volumes 57-58, September 2001, Pages 825-831, *Micro- and Nano-Engineering* 2000.