

SPECIFICATIONS FOR AN ULTRAHIGH VACUUM SCANNING PROBE MICROSCOPE

I. TECHNICAL REQUIREMENTS

The Contractor shall provide an ultrahigh vacuum (UHV) scanning probe microscope (SPM) set-up, including both a scanning tunneling microscope and an atomic force microscope (STM/AFM). The purpose of this acquisition is to allow for the study of the morphology of organic molecular films and film interfaces used for optoelectronic devices such as organic light-emitting devices (OLEDs). The imaging of the film structures will be completed by the Government in conjunction with the on-going X-ray and ultraviolet photoemission spectroscopic measurements of the films. Consequently, it is imperative that the SPM instrument be easily integrated to a UHV chamber housing the Omicron Multiprobe P/XP photoemission instrumentation. The UHV-SPM set-up must meet or exceed the following specifications.

A. Performance – The SPM must have a demonstrated *atomic resolution* on S9111) 7x7 in STM mode (z-resolution 0.01 nm), on Mica and on Au(111) in contact mode AFM and on Si(111) 7x7 in non-contact AFM mode. The switch from the STM to the AFM mode imaging should be achieved through software control without recabling the SPM instrument. The SOM head is expected to accept both STM tips and all the commercially available AFM cantilevers. The SPM instrument must also have multi-mode operation capabilities, i.e., simultaneous *STM-AFM imaging*. The control software is additionally expected to include *nanostructuring tools* for user-defined patterns. The SPM sample manipulation and transfer system must allow *a fully compatible sample transfer* between the SPM and the photoemission chambers.

B.

1. UHV STM/AFM head suitable for STM mode, AFM contact mode and AFM non-contact mode imaging consisting of:

- tube scanner with the minimum range of 8x8x3 um³
- flange-mounted AFM/STM stage with vibration isolation
- two-dimensional coarse positioning system
- in-vacuum current-voltage (I/V) converter for STM operation
- a single set of cables for both AFM and STM

2. Set of SPM tips containing
 - 20 or more STM tips mounted on tip holders
 - 20 or more AFM cantilevers for contact mode mounted on cantilever holders
 - tip and cantilever holders
 - set of sample plates and test samples for UHV AFM/STM
3. Cantilever gluing device for mounting all types of commercial cantilevers on cantilever holders
4. Beam alignment and tip approach-monitoring system consisting of
 - CCD camera
 - Light source
 - Macro zoom lens
 - Monitor
5. UHV chamber for installing the SPM head with the following:
 - 8" OD CF bolt-on flange for installing the SPM chamber onto the photoemission chamber
 - 8" and 6" OD CF view ports (minimum one each)
 - one CF flange for mounting a pincer grip wobble stick
6. Pincer grip wobble stick for cantilever and tip transfer, and sample manipulation between the SPM and the photoemission chambers with the following:
 - sufficient travel distance to perform all the required operations
 - CF flange mounting to the UHV chamber

C. SPM Control Electronics and Software

1. SPM control unit for STM and AFM operation including:
 - real-time measurement controller
 - high performance serial bus interface (IEEE 1394 or another interface card with comparable performance)
 - coarse positioning board
 - piezo driver for tube scanner
 - digitally controlled analog feedback loop for STM and AFM operation
 - DAC boards for STM measurements
 - Twin AD board for simultaneous two-channel data acquisition
 - FM detection, resonant excitation circuit and oscillator unit for non-contact AFM operation

2. Windows NT computer including

- interface card for data acquisition (IEEE 1394 or another interface card with comparable performance)
- processor specifications to current standard
- minimum hardware configurations: 128 MB RAM, 8 GB HD, CD-RW drive, 3.5" floppy disk drive, Ethernet, keyboard, mouse, Windows NT and control drivers installed
- 21" color monitor

3. SPM control software package installed including *free upgrades*

II. TERMS

Upon delivery, the Contractor shall provide installation of the SPM instrumentation, training, and demonstration of the performance of AFM and STM methods to the specifications in UHV as listed above in 1. A.