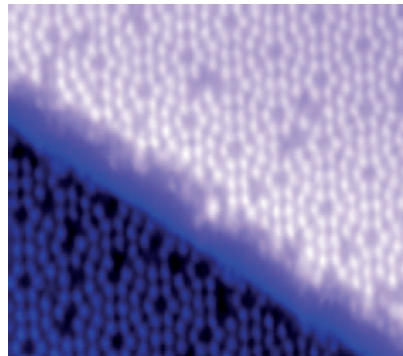
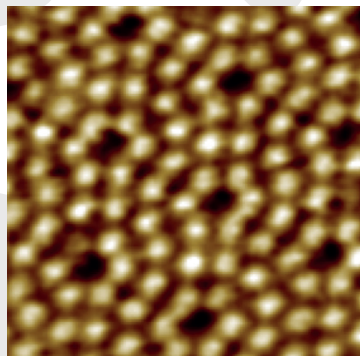
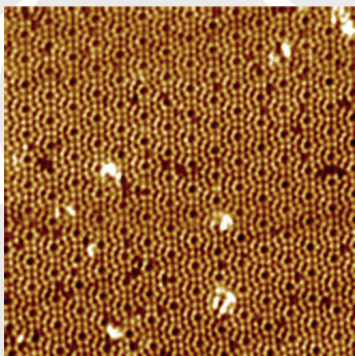
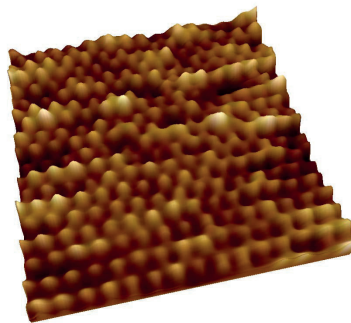
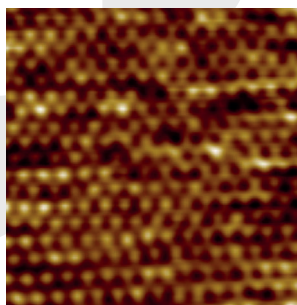
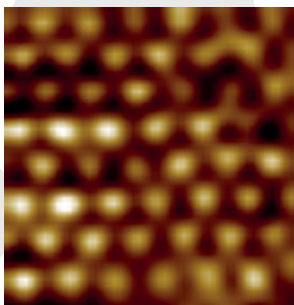


# hpSPM Controller

State of the art FPGA based controller for Scanning Probe Microscopes

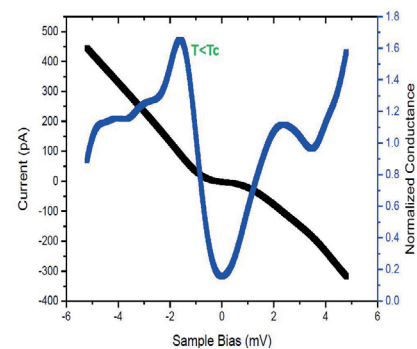


Si(111) (7x7) UHV STM Image



STM Topography of NbSe<sub>2</sub>

3D Topography



STS Data

## Technical Specification

### Signal Processing

- State of the Art FPGA Based Controller
- Reconfigurable digital hardware for ultimate performance
- 32 Bit Realtime Processor with 128MB DDR SDRAM
- USB2.0 High Speed Interface, 480Mbps for PC Interface

### Imaging Options

- STM / AFM / KPFM / ncAFM

### STM Current Range

- $G = -1V/nA$ , 1pA – 1nA Range, < 5fA/ $\sqrt{Hz}$  noise floor, no visible line or harmonics

### Bias Voltage

- Sample bias  $\pm 10V$  / 16 Bit Fast DAC, Digital Modulation for KPFM & STS

### Feedback Loops

- Hardware Implemented 7 Independent Channels of Digital Feedback Loops

### PID Loops

- Inputs: Any 24/32 Bit digital inputs from PLL etc. or any Analog input (with 24 Bit ADC)
- Outputs: 16 or 24 Bit Digital to Analog Converters & 48 Bits truncated into 24 or 32 Bits Digital Outputs

### Digital PLL/Lock-in Amplifier

- 2 Digital Lock in Amps, 32 Bit digital output (one is for PLL)
- Frequency Range : 100Hz – 1MHz
- Resolution : 40nHz
- Demodulation Bandwidth: 50Hz – 5kHz
- Input:  $\pm 10V$ , Sampling Rate: 90MHz @ 16 Bit resolution
- Output: 32 Bit digital  $\Delta f$  and Phase / 16 Bit Analog  $\Delta f$  and Phase
- Constant amplitude feedback or Constant Excitation
- Digital Filter Bandwidths: 10Hz – 3kHz adjustable

### ADCs (High Speed)

- 2 Channels of 16 Bit Analog to Digital Converters @ 90MHz;
- $\pm 10V$  Input range; 1MHz 4th order Butterworth LPF

### DACs (High Speed)

- 2 Channels of 16Bit Digital to Analog Converters @ 90MHz;  $\pm 10V$  Output range (One used for Bias Voltage)

### Scan DACs (High resolution)

- 4 Channels of 24 Bit Digital to Analog Converters @ 62.5kHz;  $\pm 10V$  Output range (XYZ & SPARE or NSEW)

### ADCs (High resolution)

- Simultaneously sampled 16 Channels of True 24 Bit Analog to Digital Converters @ 175kHz;  $\pm 10V$
- Input range; 10kHz 4<sup>th</sup> order Butterworth LPF

### DACs

- 2 Channels of 24 Bit and 12 Channels of 16 Bit Digital to Analog Converters;  $\pm 10V$  Output range

### High Voltage Amplifier

- 5 Channel Low Noise & High Voltage Amplifiers,  $\pm 200V$  Swing

### Coarse Approach Motor

- Adjustable High Voltage Pulser:  $\pm 200V$
- Slew Rate : 400V/2 $\mu s$  @ 33nF Capacitive Load
- 19 Channels of Slider Outputs programmable outputs with mechanical relays
- Choice of Slider waveforms: Exponential / t<sup>2</sup> /Linear/ Time reversed exponential
- Joystick and Software user interface

### Imaging Channels

- Simultaneous Scan of 16 channels 24 Bit ADCs and Digital Inputs like  $\Delta f$ , Amplitude etc @ 8192x8192 pixels

### Power Requirements

- 100/110/220/240 Vac, 50/60 Hz, 500 VA

### Workstation Range

- Top of the PC Workstation with Windows 10 OS and Dual 27" LCD Display

### Dimensions

- 150mm Height x 483mm Width x 520mm Depth

### Software & Drivers

- Source code written in C # and DirectX 11 for 64 Bit OS LabView™ drivers for scripting
- Software customization upon request
- Free software upgrades for Lifetime
- Source code may be available with NDA etc.