P-OGD13: A new control electronics for scanning probe microscopy

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We present a recently developed control electronics which can be used for almost any type of scanning probe microscopy, e.g. scanning tunneling microscopy (STM), atomic force microscopy (AFM) or near-field scanning optical microscopy (NSOM). It is characterized by the following features:

- Various scan modes (constant height, constant current, constant external feedback)
- Easy zooming and panning of the measured pictures
- Electronic compensation of temperature induced mechanical drift of the scan head
- Electronic plane subtraction for the compensation of sample inclination
- Simultaneous measurement of up to 6 parameters, each selectable from a variety of 100 internal or external signals
- High speed surface scanning for measuring of surface adsorbates with a high mobility in real-time
- Spectroscopy modes to measure local electronic properties
- Programmable reaction to external or internal interrupt conditions while scanning
- Full software control of the microscope by a personal computer linked by high speed data communication

Low noise STM current preamplifier (equivalent noise 3.3 pA RMS at a signal bandwidth of 7.7 kHz)

High voltage amplifier (output range 200 V, electronic noise 250 $\mu$V RMS at a signal bandwidth of 18 kHz, slew rate 8 V/$\mu$s)

The electronic system is controlled by two self-designed CPLD microcontrollers (central processing unit and scanner control unit) with dedicated assembly commands and program memory. Control programs are generated using the connected personal computer and downloaded via a high speed data link which provides a high degree of flexible, distributed intelligence for complex measurement tasks. Output data are buffered in the memory banks of the central processing unit and can be efficiently retrieved by the personal computer. The main control program, MultiScan, runs on a personal computer under the operating system Windows NT / 2000 / XP. Its functions can be controlled by direct user interactions using menus and dialogs or by scripting programs written in BASIC or JAVA. The complete system was thoroughly tested using a Besocke-type STM scan head operated at atmospheric pressure and inside a UHV chamber.

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