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Soft X-ray Microscopy Project at NSRL

Xingshu Xie[1,2], Chengzhi Jia[1], Yongfei Zhao[1], Lei Shang[1], Jiangyang Zhang[1], Xiangtung Xu[2] and Xhiping Jiang[2]

[1]*Center for Fundamental Physics*

[2]*National Synchrotron Radiation Laboratory, University of Science and Technology of China, Hefei 2300226, China*

The Hefei Synchrotron Radiation Facility, a national synchrotron radiation source was operated and available for experiments at the end of 1991. This 800 Mev storage ring produces the synchtotron radiation in the spectral range from infared to VUV and soft x-ray microscopy has been planned at Hefe National Synchrotronyn Radiation labortory (NSRL) since 1984 (Xie et al.) The aims of our soft x-ray microscopy project are the construction of a soft x-ray scanning microscope, development of soft x-ray scaning microscope, development of soft x-ray scanning microscope, development of soft x-ray contact imaging techniques and demonstration of the unique capabilites of soft x-ray microscopy in high resolution, element-specific studies of biological specimens. We also begin the project of other types soft x-ray imaging study, e.g. x-ray holography.

A Prototype scanning transmission x-ray microscope has been installed in beamline U12A. In the first generation of our instrument the x-ray probe is formed by a 2μm pinhole. We have tested this scanning x-ray microscope and obtained the real time x-ray image using synchrotron radiation. The specimen on stage is mechanically scanned across the x-ray spot. The continuous scan (50μm × 50μm) is generated by a pair of PZTs and the fast scan direction is horizontal. The PZTs ar driven by fast, high voltage (1000) operational amplifiers which are controlled by low voltage signals from a CAMAC DAC. The position is sensed by a pair of LVDTs, the outpu of which is converted to a voltage by a high gain signal processor and inputted to two channels of a CAMAC ADC. The x-rays transmitted by specimen are detected by a flow gas proportional counter which is fabricated in our lab. The x-ray micrograph is displsyed on a color monitor via the video display interface and can be stored on a hard disk or diskette. Simple image processing can be done in thses stored images including changing contrast and color level, pixel size and starting position (Xie et al.). The effort of constructing a new x-ray scaning microscope is undertaken. In the next generatio of the instrument a high resolution micro zoneplate with outermost zonewidth 45 nm which was fabricated at IBM (Anderson et al.) will be used to focus the x-rays. An improved scanning stage and an x-ray image processing system also will be made.

Studies of soft x-ray contact microscopy have been performed using ysnchrotron radiation. We designed and built a prototype device for doing the specimen exposure with synchtotron radiation. This device is vacuum compatible and convenient for the specimen handling. Typical time to reach pressure of the order of 10-5 torr is about 10 minutes. The specimen holder consists of five holes in which one is painted on P-31 phosphor for beam alignment and others hold specimen-resist assembly. The holder can be moved toexact position through a linear feedthrough. We also developed and tested a wet specimen chamber. A Si3N4 window of thinkness 1000Å is used to seperate the beamline vacuum ad the expasure area. The Si3N4 windows which is fabricated in our laboratory has been used with-out breaking and leaking. Exposures in a broad-hand beam and monochromatic beam have been made. Simple grid and some biological specimens have been chosen for examination and demonstration (Jia et al.).

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