L-04 **Monday, 13.06., 17^{40} - 18^{20}**

Unusual observation of image potential states of nanosized Ag clusters, observed by direct photo emission

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Ag films are grown by Van der Waals epitaxy on cleaved WSe_2 (0001) surfaces. For low coverage the growth mode is Volmer-Weber type leading to (111) oriented islands as demonstrated by LEED. Islands of about 70 nm diameter for a nominal 3 Å film grow in registry with the substrate. For p-type substrates a surface photovoltage is generated at the Schotky barrier between substrate and film, which can be easily followed by the position of the Schockley type surface state S1 of the Ag(111) surface exposed to vacuum. For low photon energies an emission out of image potential states belonging to the Ag(111) surface are observed directly in normal photoemission: These emissions are lost for thicker films when a continously closed film is prepared. Normally image state emissions are only observed by inverse photoemission or two photon photo emission experiments. Here the emission is explained by a roughness induced lowering of the potential barrier at the sides of the clusters leading to a direct photoemission below the nominal workfunction of the (111) surface.

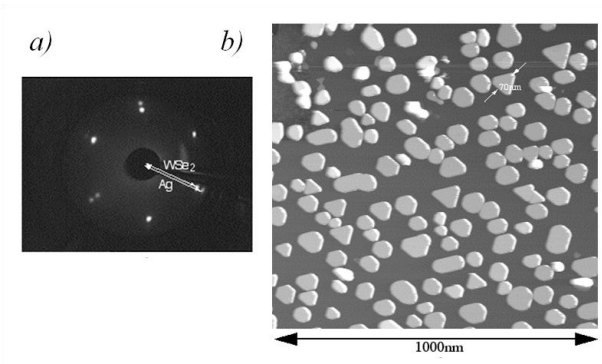

Figure 1: a) LEED pattern of 12 Å Ag on WSe_2, 66 eV; b) STM image of 10 Å Ag on WSe_2.

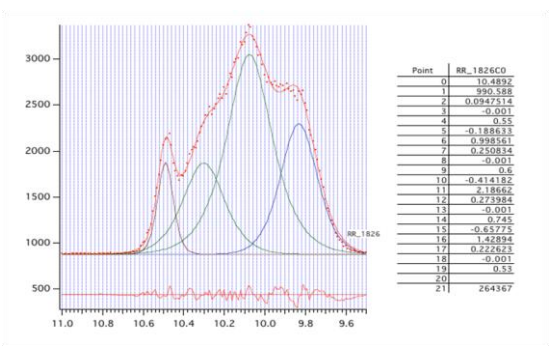

Figure 2: Spectrum taken with 4.6 eV E_{phot} for 6 Å Ag film.

L-05 **Session A, Tuesday, 14.06., 9^{00} - 9^{40}**

Double pulse X-ray Photon Correlation Spectroscopy using hard X-ray delay line

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Keywords: hard x-ray delayline, free-electron laser, coherence

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The conventional X-ray Photon Correlation Spectroscopy (XPCS) [1] technique at 3rd generation synchrotron sources is routinely probing nanoscale dynamics of condensed matter systems (e.g. capillary wave flucutations, magnetic domain fluctuations, rheological properties of soft matter, dynamics in glass-forming systems) at time scales between milliseconds to hours. X-ray Free Electron Lasers (XFEL) based on Self Amplified Spontaneous Emission (SASE) deliver ultra-fast and spatially highly coherent hard X-ray radiation with extreme peak brightness
($\approx 10^{12}$ photons in a single pulse) making it an ideal probe for studying atomic-scale dynamics in various condensed matter systems whose characteristic times can be considerably shorter than time resolutions provided at storage rings (≈100 ps). At the existing X-ray FEL sources, the time resolution of XPCS measurements is defined by the repetition rates of the X-ray pulses to few milliseconds. Moreover due to severe fluctuations in intensity and position of the FEL pulses [2], it is difficult to obtain proper photon correlation between successive scattering signals. In principle, these obstacles can be overcome by employing the "split-delay" approach i.e using hard X-ray delaylines [3].

Here, we report on successful implementation of the hard X-ray delayline [4,5] at the Linac Coherent Light Source. The device is capable of providing two X-ray pulses with controllable time delays ranging from a few femtoseconds to nanoseconds, which is sufficient for probing ultrafast phenomena in versatile choices of condensed matter systems. The measured throughput of the device within 1.47×10^{-5} energy bandwidth of the exit beam at 7.9 keV is 30% [5]. The X-ray FEL pulses after the X-ray delayline are used to generate high (69%) contrast speckle patterns from nanoparticles (as shown

in Figure 1), which is only possible due to the well-preserved transverse coherence. Measuring intensity fluctuations also reveals that only a single or double temporal modes remain in the beam, indicating the delivery of near Fourier transform limited pulses. We also successfully performed a proof of principle Split Pulse XPCS experiment on a model system of small (R = 1 nm) gold nanoparticles dispersed in hexane solvent with hard x-rays and obtained the first time autocorrelation function in the ns time domain.

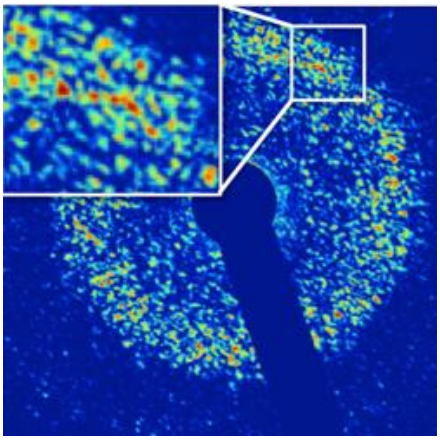

Figure 1. Typical pattern showing randomly oriented speckles.

Acknowledgments: We thank the Hamburg Centre for Ultrafast Imaging (CUI) for financial support. The Linac Coherent Light Source (LCLS) at SLAC National Accelerator Laboratory, is an Office of Science User Facility operated for the U.S. Department of Energy Office of Science by Stanford University. S. Lee was supported by the Converging Research Center Program through the Ministry of Science, ICT and Future Planning, South Korea (NRF-2014M3C1A8048818, NRF-2014M1A7A1A01030128).

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L-06 **Session A, Tuesday, 14.06., 11^{40} - 12^{20}**

Towards compact short wavelength Free Electron Laser using laser plasma acceleration

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Keywords: free-electron laser, laser wakefield acceleration, undulator

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More than 50 years after the lasers discovery [1] and more than 30 years after the first Free Electron Laser (FEL) using relativistic electrons in a periodic magnetic field as a gain medium [2], the advent of X-ray free elctrons lasers open new paths for investigation of matter for imaging, ultra-short phenomena for example. The emergence of the femtosecond, high power (typically GW), peak and average brilliance, tunable X-ray FELs constitutes a major scientific revolution, after the one brought by the laser invention. FEL user facilities (FLASH [3], FERMI@ELETTRA in the seeded configure tion [4], LCLS [5] and SACLA [6] in the hard X-ray) enable to harvest new scientific results in unexplored scientific areas. Present X-ray FEL are usually built on linear accelerators of high beam quality, delivering nC charge, with 0.01 % energy spread and 1 µm.rad emittance.

While additional X-ray FEL centers are under construction, new directions are also taken, such as operation at high repetition with multiplexed FEL beamlines with FELs relying on superconducting linear accelerators, advanced seeding, and compactness in considering reducing the size of each constituting components. Besides advanced seeding schemes [7] and compact undulators [8]. Besides, one also considers replacing the conventional linear accelerator by a compact one system relying on an alternative concept, such as dielectric acceleration, inverse FEL and Laser Plasma Acceleration (LPA) [9]. In LPA, a short multi-TW laser pulse in focus in a gas jet (cell, capillary) and drives strong plasma waves in its wake [10, 11] which can drive the electron acceleration to GeV on a mm scale. Synchrotron radiation has been already observed with LPA [12-15]. But the present electron divergence (1 mrad) and energy spread (of the order of 1 %) does not match the present performance of conventional linear accelerators used for short wavelength FELs. In consequence, an adequate beam manipulation through the transport to the undulator is needed for FEL amplification. One first strategy is to use a demixing chicane to sort out the electrons in energy and reduce the slice energy spread by typically one order of magnitude [16, 17]. One can even take advantage of this introduced correlation to focus the electron slices in synchronization with the progress of the optical wave in the undulator for higher effective electronic density [18, 19] in the so-called chromatic matching scheme. An alternative strategy is to use a transverse gradient undulator [20].