The ultrahigh resolution Inelastic X-ray Scattering (IXS) beamline at NSLS-II and opportunities for the study of fast dynamics in mesoscale

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The ultrahigh resolution inelastic x-ray scattering (IXS) beamline at NSLS-II is designed to achieve sub-meV to the ultimate 0.1 meV resolution with high momentum resolution and spectral contrast for inelastic x-ray scattering experiments. It is expected to provide unique capabilities on studies of fast dynamics in exotic material systems ranging from soft matter, colloids, and biological materials with complexity and disorders in mesoscopic length scales, to systems in confined geometries such as surfaces, interfaces and in extreme pressure and temperature [1]. The key instrument is a novel spectrometer with analyzer optics based on a highly-dispersive back-reflection optical system on a 5m scattering arm that covers a wide range of momentum transfer. Current status of the instrument and early technical commissioning results will be presented. The expected improvement in spectral contrast and the possibility to bridge the dynamic gap with existing inelastic light scattering probes at lower excitation energy and smaller momentum transfer will be illustrated using recent results obtained from conventional spectrometers on supercritical Ar highlighting the mechanism of the viscous-to-elastic crossover in liquids [2], as well as on lipid membranes examining the phonon-mediated transport mechanism in the system undergoing the Gel-Fluid phase transition [3]. The role of transverse phonon modes in both cases will be discussed.

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References

[1] Y. Q. Cai, D. S. Coburn, A. Cunsolo, J. W. Keister, M. G. Honnicke, X. R. Huang, C. N. Kodituwakku, Y. Stetsko, A. Suvorov, N. Hiraoka, K. D. Tsuei, and H. C. Wille, "The Ultrahigh Resolution IXS Beamline of NSLS-II: Recent Advances and Scientific Opportunities", Journal of Physics: Conference Series 425, 202001 (2013).

[2] D. Bolmatov, M. Zhernenkov, D. Zav'yalov, S. Stoupin, Y.Q. Cai, and A. Cunsolo, "Revealing the mechanism of the viscous-to-elastic crossover in liquids", Journal of Physical Chemistry Letters 6, 3048 (2015).

[3] M. Zhernenkov, D. Bolmatov, D. Soloviov, K. Zhernenkov, B.P. Toperverg, A. Cunsolo, A. Bosak, and Y.Q. Cai, "Phonon-mediated transport in DPPC lipid bilayer across the phase transition", *to be published*, (2015).

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