Robotic Sample Preparation and Delivery for Autonomous Material Discovery At APS-U 8-ID Beamlines

Dr. Qingteng Zhang[1]
[1]*Argonne National Laboratory*
qzhang234@anl.gov

Robotic sample preparation and delivery for autonomous material discovery at APS-U 8-ID Beamlines The advent of APS Upgrade (APS-U) and other 4th generation synchrotron sources will deliver a coherent x-ray flux >100 times higher than APS today. XPCS measurements on weakly scattering samples (e.g. Brownian dynamics of active viruses [1]) that require >15 hours to accumulate sufficient statistics for quantitative analysis will be completed within seconds. In light of the massive increase in achievable measurement throughput, as well as AI-assisted tools for data interpretation [2] and potentially radiation damage mitigation, we present robotic procedures for liquid sample assembly and delivery at Small-Angle XPCS (SA-XPCS) beamline [3], and transfer of thin film samples at the Grazing-Incidence X-ray Scattering (GIXS) beamline. These robotic procedures follow industrial standards and can be concatenated with other robotic sample preparation procedures provided by the users to achieve AI-executable digital twins of material characterization and eventually autonomous material discovery.

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References:
{1} K. Switalski et al., J. Synchrotron Rad. (2022). 29, 1429
{2} J. Horwath et al., arXiv:2212.03984 [cond-mat.mtrl-sci], https://doi.org/10.48550/arXiv.2212.03984
{3} D. Ozgulbas et al., https://doi.org/10.21203/rs.3.rs-2527169/v1