AXON as Supporting Streamlines Image Acquisition, Metadata Synchronization and Data Analysis for an In-situ Electrochemistry Experiment

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The adoption of in-situ TEM studies in a non-vacuum environment, has grown exponentially since early 2000s. Users experience the complexity of accurately reporting and reproducing such experiments. There is need to develop minimum requirements for reporting experiment conditions and parameters to improve analysis and enable the reproducibility of results by other researchers [1]. The need to standardize reporting and enable others to access metadata created during microscopy experiments was recently highlighted by Sarkans et al. as a general area for improvement within the wider biological imaging community [2]. In their review, Sarkans highlighted the FAIR principles, first proposed by Wilkinson in 2016, which identified that datasets need to meet the criteria of being (1) Findable (2) Accessible (3) Interoperable (4) Reusable [3]. In-situ TEM studies, due to both the size of the collected data and complexity are well suited to the application of FAIR principles, and the community benefits if researchers can share and mine existing datasets to identify trends and behavior.

Protochips recently introduced AXON, a software solution designed to both address specific pain-points inherent to in-situ TEM studies and to consolidate experimental parameters and metadata across platforms. AXON Studio enables the user to scrub through many images and quickly identify trends or periods in which the sample undergoes morphological changes. **Figure 1** shows an in-situ electrochemistry experiment.

Utilization of the AXON platform for in-situ experiments easily enables the application of FAIR principles to in-situ data management, and facilitates more robust analysis, data mining and review of in-situ experiments by outside researchers, increasing productivity and ultimately elevating the field of in-situ TEM.

[1] Wu. *et al*, Advanced Materials, 32, 25, (2020) p. 2001582
[2] Sarkans et al., Nature Methods (2021) https://doi.org/10.1038/s41592-021-01166-8
[3] Wilkinson et al. Sci Data, 3, (2016) p.160018

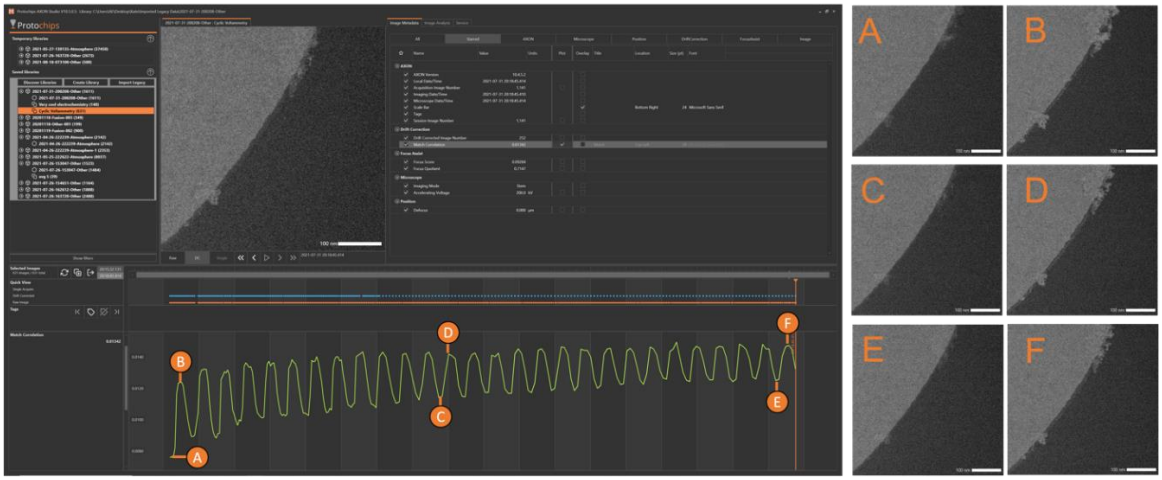

Figure 1. An in-situ electrochemistry experiment analyzed with the AXON Studio software. The match correlation data for the entire image series is plotted in green and the periodic fluctuations indicating morphological changes correspond with the plating and dissolution of silver on the working electrode that occurs during the cyclic voltammetry experiment. The TEM images that correspond to different points along the plotted match correlation data are labeled A-F.