GOAL: The aim of MA 819 is to investigate the feasibility of X-ray diffraction microscopy in imaging nanoporous metals at the formation stage. Upon reaching the goal, this will help to investigate the evolution of nanoporous metallic structures and the correlations between the changes in microstructures and nanocavities to enhance our understanding of their physical and chemical properties.

Samples: We prepared 8 nanoporous gold-silver samples by e-beam lithography and dewetting process. Some of the SEM images are shown below.

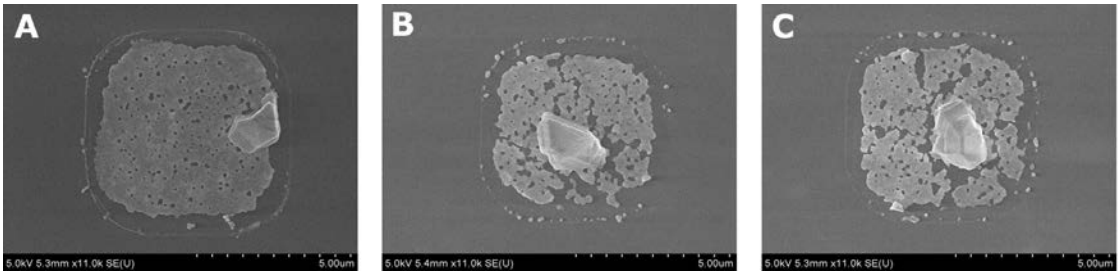

Figure1. SEM images of gold-silver porous sample, ranging a few microns in size.

Experiment result:

1. We investigated the scattering strength from prepared samples and measured coherent diffraction patterns from a few micron size metal samples with 100 nm thickness. We found that the initial pore size before dealloying process is about 5 to 12 nm. One of collected diffraction data is shown in figure 2. Even though it is promising, the pore size was too small to be measured with a currently available detector to meet the oversampling requirement for a successful image reconstruction. To overcome this limitation, we applied dealloying process (coarsening in the nitric acid) to the samples to have larger pore size. Data analysis for collected diffraction patterns is underway.

2. For future imaging of nanoporous metals in nanometer scale, 3D imaging is needed to visualize their complex microstructure and nanocavities within. We commissioned Medipix detector for the first time in the application of the coherent diffraction imaging to speed the data collection time for 3D imaging. We measured full 3D data collection from a gold sample from +70 to -44 degree at every 2-degree step size. During the 3D data collection, we noticed that the drift of the beam can be significant from one angle to the other, which called for further investigation. We were informed later that the drift problem no longer existed after the upgrade of the monochromater at ID10C.

Outlook: 1. Sample preparation by Reactive ion etching is considered for future beamtime to produce nanoporous samples with pore size ranging from 10 to 30 nm. 2. Medipix configuration within SPEC with “accumulation mode” can help speeding data analysis.

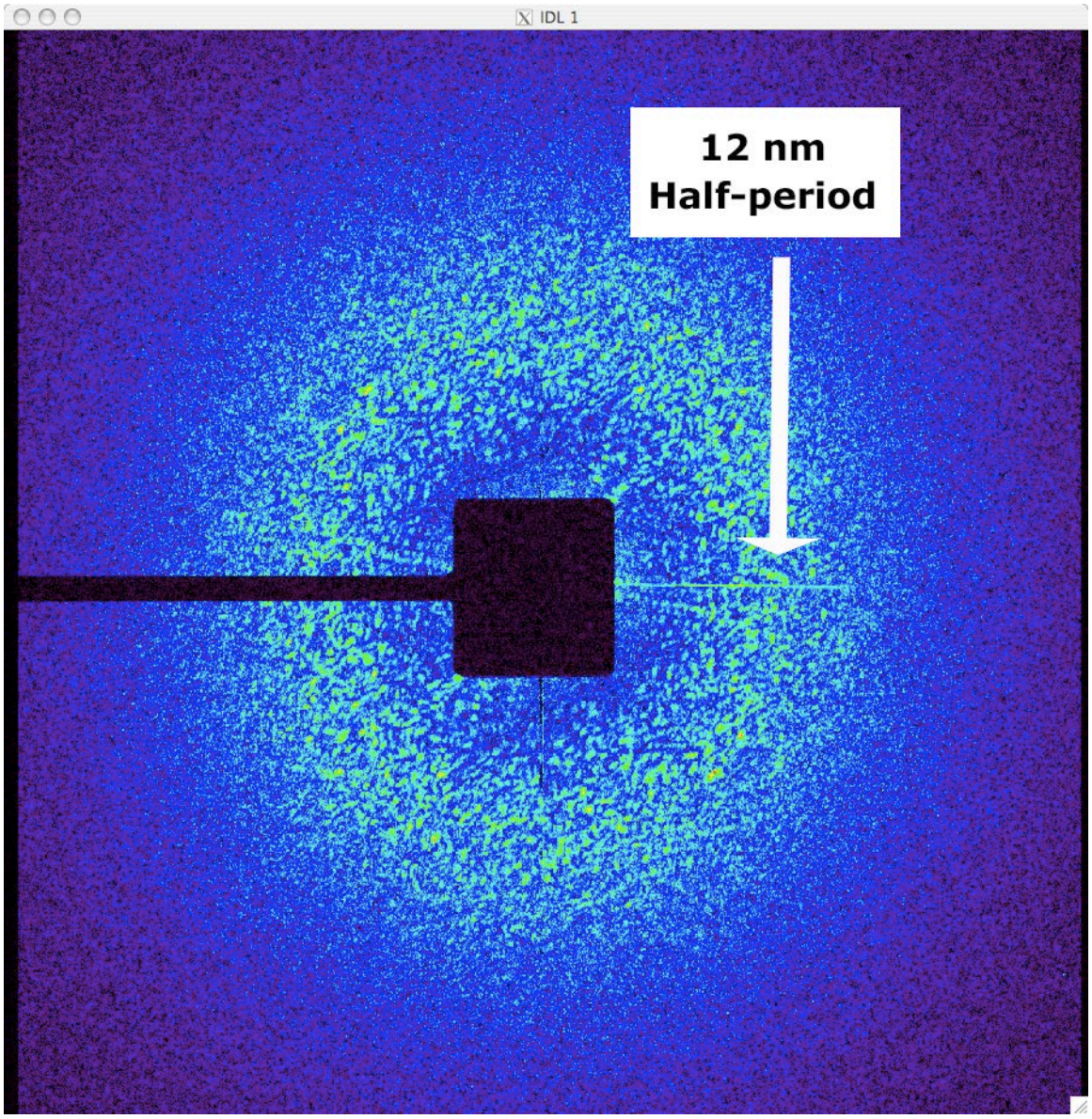

Figure 2. One of collected coherent diffraction patterns from gold-silver porous metal. The spatial frequency at the edge of the detector corresponds to 7 nm half-period.