

# Imaging a sample in the aperture holder of the Helium Ion Microscope.

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Our group is using a commercial Si complementary metal-oxide-semiconductor (CMOS) camera (Advacam, Minipix, 55-micron pixel pitch) to image scattering of a focused He (10 – 30 keV) ion beam transmitted through various materials [1, 2]. The direct He ion detection is via electron-hole pair current in the array of surface barrier diodes in this camera [3].

Due to the short de Broglie wavelength of our ion beam (100 fm), the geometry of the He ion microscope (HIM), and the camera pixel size, phase contrast, if present, remains unresolvable under standard imaging conditions. The spatial and temporal coherence length of the source has not been measured.

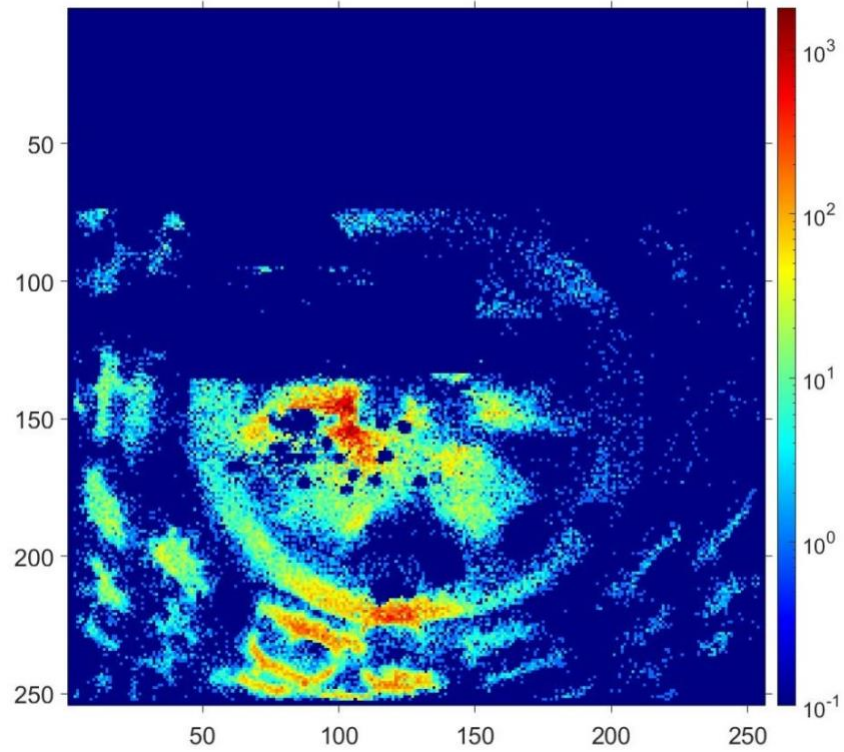
Placing the sample in the aperture position of our Helium Ion Microscope (Zeiss Nanofab) allows us to utilise the second of two electrostatic lenses for magnification. With the beam incident on a sample in the aperture below the first lens, the acquired image is magnified by the second lens onto our digital camera in transmission mode. The figure attached shows examples of images obtained with this geometry, from transmission through a sample on a hexagonal TEM grid in the aperture holder. We plan to characterise images from various sample types and present results from these experiments at the meeting.

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[1] Karen L. Kavanagh, Aleksei Bunevich, and Mallikarjuna Rao Motapothula, ArXiv submit/311553 [cond-matt.mes-hall] 3Apr 2020.

[2] Jiaming Wang, Symphony H. Y. Huang, Christoph Herrmann, Shelley A. Scott, François Schiettekatte, and Karen L. Kavanagh. *J. Vac. Sci. Technol B* **36**, 021203 (2018); doi: 10.1116/1.5020667.

[3] K. L. Kavanagh, C. Herrmann, J. A. Notte, *J. Vac. Sci. Technol. B* **35**, 06G902 (2017).



Transmission image with the focus on a TEM grid: Ted Pella 6-8 layers Graphene. Sample is in the L1 slot of beam limiting aperture, above the objective lens. 256x256 pixel array ADVACAM X-ray camera. Number of counts on each pixel corresponds to the number incident Helium ions.