Cellphone CMOS Camera Module for Imaging with Charged Particle Beams.

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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]. For 30 keV ion energy, they slowly lose sensitivity until completely failing to detect He ions after an implantation of 3 M ions per pixel, presumably due to near-surface radiation damage [4]. However, we find that they continue to work well for the detection of the deeper-penetrating electrons in our transmission electron microscopes (TEM) (200 keV).

Various types of CMOS image sensors are widely used for optical imaging with the industrial market moving towards smaller pixel sizes. Back-Side-Illumination (BSI) technology dominates current designs [5] and allows us to safely remove surface layers on top of the typical silicon photodiode, without disturbing the underlying circuitry. Our group has successfully acquired electron beam images from one such modified camera (Omnivision OV5648 image sensor, 5 Mpixels, 1.4x1.4 um^2 pixel size.). The figure attached shows examples of electron diffraction patterns obtained via a used x-ray camera (a) and a cellphone camera (b). We are investigating how these cameras perform in our TEM (Hitachi 8000) and our He ion microscope (HIM, Zeiss Nanofab) in comparison to an existing commercial CCD camera (TEM). We will present results from these experiments at the meeting.

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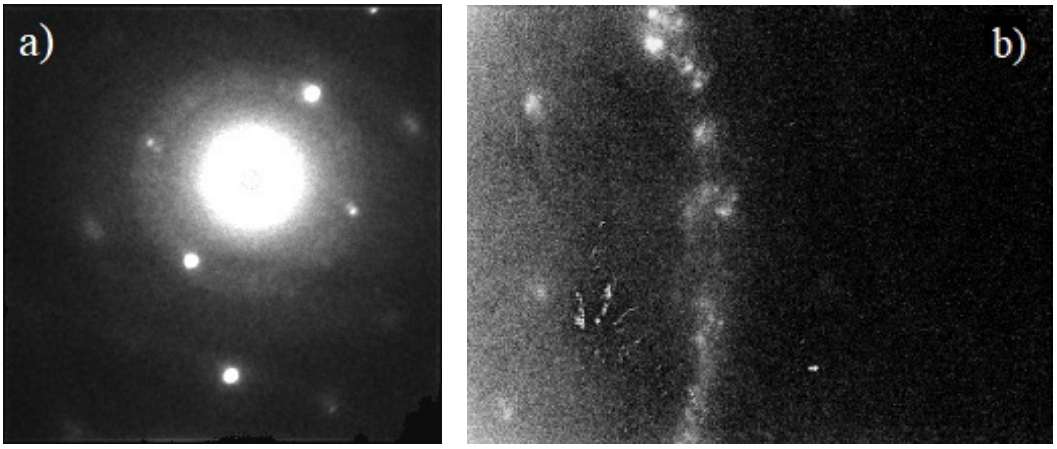

Electron diffraction patterns from different nanostructures (a) Advacam Modupix, 256x256, 55 μm square pixels, (b) Omnivision OV5648, 2592x1944, 1.4 μm square pixels.