Electron Reflection From Metal Targets

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The proposed Reflection Electron Beam Lithography system, REBL, described by Petric et al [1] relies on well-controlled electron reflection from an array of electrodes. Here we describe a technique for comparing electron reflection from different metal targets as a function of applied voltage. The apparatus (Figure 1) uses a low energy spread [2] (<1 eV) photocathode in conjunction with rotationally symmetric electrodes. A 257nm laser excites the CsBr/Cr photocathode at ground potential. The electrons are accelerated by an extractor electrode (~1 kV) a few mm from the cathode, pass through the extractor electrode, then decelerated by the collector electrode and impinge normally onto the metal target. As the metal voltage V_m is made more positive the reflected current decreases and the absorbed increases. We can see from Fig. 1 that Ipc=Iext + Im. The potential and shape of the extractor and collector electrodes can be optimized to give the sharpest cutoff of the curve of Iext vs V_m. Values of normalized reflected current (1-Im/Ipc) and the extractor current I_{ext} as a function of metal bias voltage indicate a sharp cutoff as small as 0.9 volts (Fig. 2) consistent with the measured photocathode energy spread. These results were for an unpolished Cu target and an early, unoptimized, electrode geometry. Contributions to the width of the cutoff include the energy spread of the incident electrons, spatial variations in the work function of the metal and the landing angle of the electrons. Experiments with an improved arrangement are underway.

1. Juan R. Maldonado, Yun Sun and Zhi Liu, Xuefeng Liu, Sayaka Tanimoto, Piero Pianetta, Fabian Pease, Evaluation of electron energy spread in CsBr based photocathodes, J. Vac. Sci. Technol. B Volume 26, Issue 6, pp. 2085-2090 (November 2008)
2. REBL: A novel approach to high speed maskless electron beam direct write lithography, Paul Petric, Chris Bevis, Allen Carroll, Henry Percy, Marek Zywno, Keith Standiford, Alan Brodie, Noah Bareket, and Luca Grella, KLA-Tencor Corporation, 160 Rio Robles, San Jose, California 95134, J. Vac. Sci. Technol. B, Vol. 27, No. 1, Jan/Feb 2009.

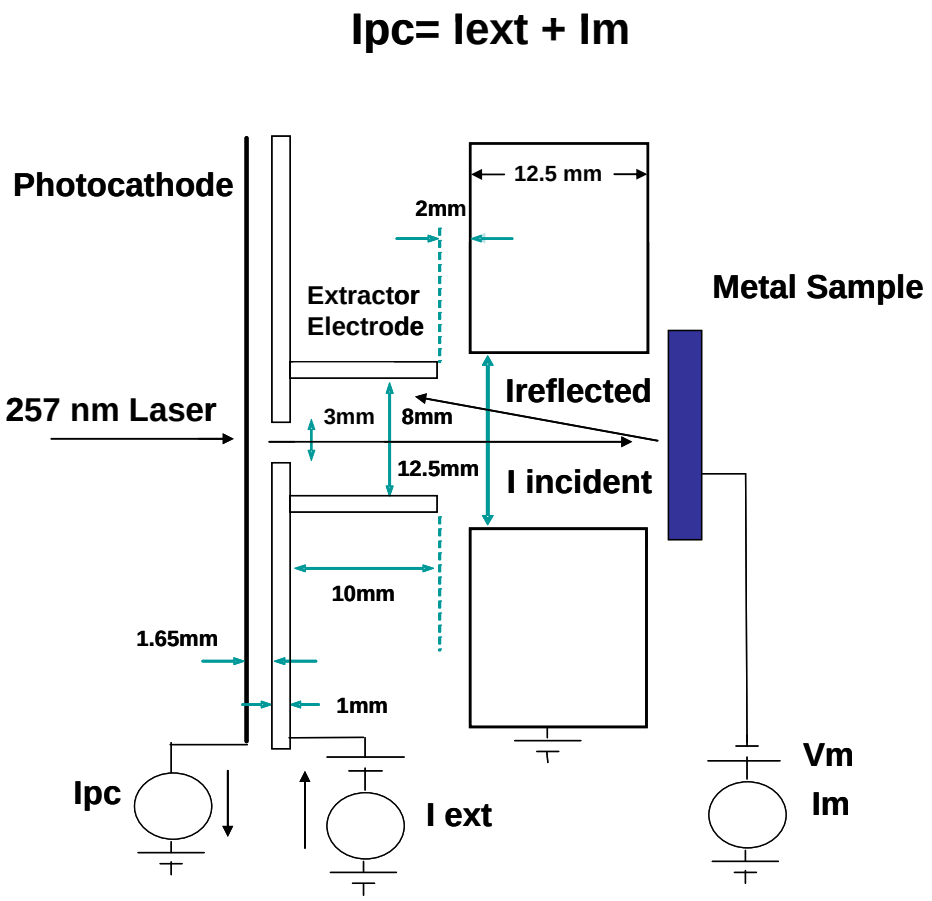

Figure 1. Experimental Set up (some spurious currents are not shown)

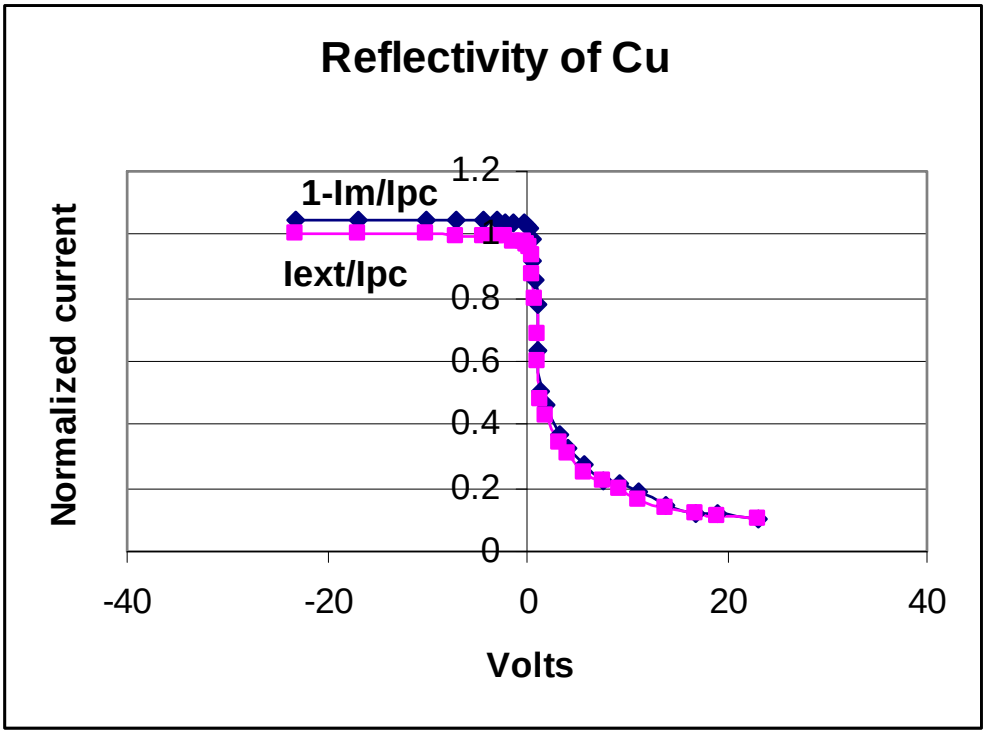

Figure 2 . Measurements obtained in a machined copper sample