CURRENT DEPENDENT FIELD EMISSION PERFORMANCE TEST USING A CMOS IMAGING SENSOR

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ABSTRACT

In this contribution, a measurement routine for comprehensive comparison of field emitters is proposed. For this purpose, a recently published method for field emission imaging [1] is combined with a previously presented performance test [2]. In contrast to typical field emission measurements in the literature, the emitter is subjected to one-hour constant current measurements (CCM) at several current levels. Starting at 10 nA, these current levels are successively increased until the emitter can no longer supply the set current at a maximum extraction voltage of 1 kV limited by the measurement setup. Current-controlled current-voltage sweeps before and after each CCM allow the extraction of characteristic values, such as beta factor or effective emission area, whereby the degradation of the emitter during the CCM can be investigated. The samples investigated here are field emitter arrays (FEAs) fabricated by saw dicing and TMAH etching [3]. A crucial factor for the degradation of FEAs and thus their lifetime and general performance is the homogeneity of the current distribution across the array. With a CMOS camera as the extraction anode, the distribution of the current load can be observed during the entire measurement process. A Python algorithm, detects and evaluates the emission spots automatically. Thus, the distribution of the current can be analyzed at any time during the integral measurement. By using different exposure times, an information loss due to saturation of CMOS pixels can be avoided and therefore a congruent course of integral current and pixel brightness can be achieved. This also allows the extraction of characteristic curves for individual tips from the integral measurement, which in turn can be examined for characteristic values. The presented measurement routine thus offers an unprecedented amount of information about the emission characteristics of arbitrary FEAs. The defined procedure is intended to provide a basis for comparison, which allows a systematic optimization of FEAs.

References

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