Silicon MOSFET / Field Emission Arrays Fabricated Using CMP

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We report the integration of a MOSFET with a field emission arrays to obtain low voltage switching and more stable emission in field emission devices. Instead of the traditional feedback resistor stabilization in the emitter circuit, a MOSFET is used as a voltage controlled current source thereby stabilizing the emission current and resulting in low voltage switching. In this device, the emitter electrode of the field emission array is the drain of the MOSFET. The device operates by controlling the electron supply to the emission surface through the inversion layer density in the channel region of the MOSFET. However, the device is only effective in reducing noise when the MOSFET is biased in the saturation regime. Our devices were fabricated using isotropic etching, oxidation sharpening and chemical mechanical polishing.

Electrical characterization of integrated MOSFET/FEAs devices was conducted in UHV at a pressure of $1x10^{-9}$ Torr. The average turn-on voltage of FEAs is 24V. The threshold voltage of a LD-MOSFET is about 0.5 V. The gate oxide thickness is 50nm and the electron mobility in the transistor is calculated to be 430 cm^2/V-sec. The subthreshold slope is 98.6 mV/decade. MOSFET/FEA is off when the transistor gate voltage is below threshold. At a MOSFET gate voltage slightly above the threshold voltage, the emission current initially is controlled by the transmission through the tip surface barrier. As FEA gate voltage increases, the emission current saturates indicating that emission current is controlled by the electron supply from the inversion layer.

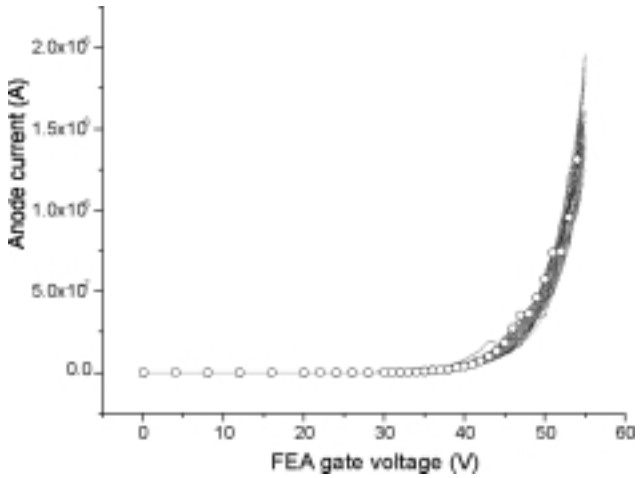

Fig. 39: IV sweeps of a 10x10 FEA. Lines are the up and down sweep measurements and the open circles represent the IV sweep of the 11th peak

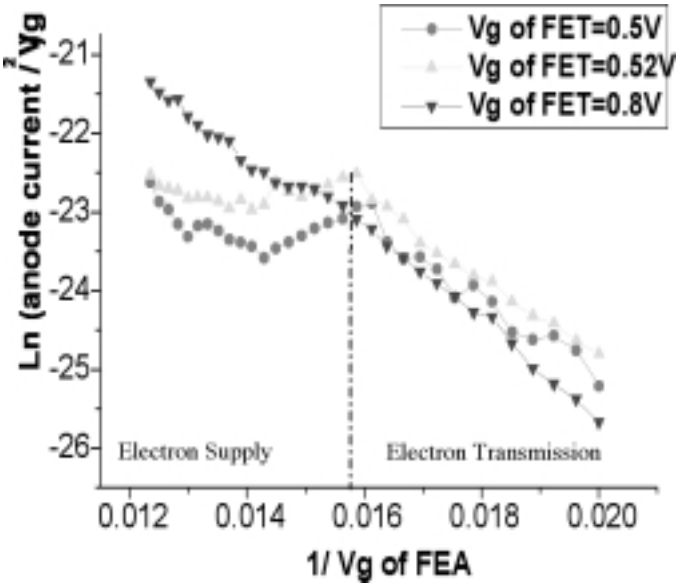

Fig. 40: FN plot of an integrated MOSFET/FEA device