Analysis of a diode with a ferroelectric cathode

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It has been shown experimentally that electron current densities of more than 30 A/cm^2 can be achieved from a cathode made of ferroelectric ceramic, when applying a field of order 0.1 MV/m. This current exceeds the Child–Langmuir current by two orders of magnitude. The current in the diode varies linearly with the applied voltage, provided that the latter is positive. In this theoretical study we show that the ferroelectric material plays a crucial role in the emission process. When a voltage is applied to the ferroelectric, the internal polarization field varies and the amount of screening charge required decreases. As a result, the electrons distribution near the cathode changes, forming a cloud which fills part of the diode gap. If now a positive voltage is applied to the anode, electrons are readily transferred through the diode gap. The qualitative and quantitative results of the theory are in good accordance with the experiment.