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Development of a Near-Relativistic Electron Beam Source using a Pyroelectric Crystal Array[1] RODNEY YODER, JONATHAN JEFFERSON, DANIEL LERNER, Goucher College — Novel laser-powered acceleration structures currently under development have the potential to produce GeV/m acceleration gradients in a microchip-scale structure. Such structures, which necessarily have dimensions comparable to optical wavelengths, will require injection of a sub-micron-scale electron bunch at near-relativistic energies to achieve high-quality, monoenergetic output beams. One possible injection mechanism relies on field emission from a nanotip array, followed by acceleration in optical or DC fields. We have demonstrated field emission of kilovolt electrons from a carbon nanotube (CNT) layer, using the quasi-DC fields produced by a pyroelectric crystal (lithium niobate) during slow heating and cooling. Results compare well with mathematical models. Further, we describe a method for producing near-relativistic electrons via pyroelectric materials using a similar approach, involving a narrow vacuum channel through the center of a three-crystal array. This arrangement is predicted to produce highly uniform accelerating fields of tens of MV/m, with output energy > 200 keV, leading to applications as a stand-alone radiation source in addition to injection. A proof-of-principle experiment in this geometry is underway and will be discussed.

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