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Quantum efficiency and lifetime study for negative electron affinity GaAs nanopillar array photocathode

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Recent studies showed significant improvement in quantum efficiency (QE) by negative electron affinity (NEA) GaAs nanopillar array (NPA) photocathodes over their flat surface peers, particularly at 500 \times 800 nm waveband. However, the underlying physics is yet to be well understood for further improvement in its performance. In this report, NEA GaAs NPA photocathodes with different dimensions were studied. The diameter of the nanopillars varied from 200 \times 360 nm, the height varied from 230 \times 1000 nm and the periodicity varied from 470 \times 630 nm. The QE and photocathode lifetime were measured. Mie-resonance enhancement was observed at tunable resonance wavelengths. Simulations were also performed to understand the mechanism of photo-absorption and possible ways to further improve the photocathode performance to meet the stringent requirement of the electron sources in large scale electron accelerators.

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