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Quest for an optimal spin-polarized electron source for the Electron Ion Collider

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Superlattice GaAs photocathodes play a crucial role as the primary source of polarized electrons in various accelerator facilities, including CEBAF at Jefferson National Laboratory and the Electron Ion Collider (EIC) at Brookhaven National Laboratory. To increase the quantum efficiency (QE) of GaAs/GaAsP superlattice photocathodes, a Distributed Bragg Reflector (DBR) is grown underneath using metal organic chemical vapor deposition (MOCVD). There are several challenges associated with DBR photocathodes: the resonance peak may not align with the emission threshold of around 780 nm, non-uniform doping density in the top 5 nm may significantly impact QE and spin polarization, high-temperature heat treatment may lead to interlayer material diffusion, and the number of DBR pairs may not be optimal, affecting both QE and spin polarization. In this paper, we will report our progress of addressing these challenges to hunt for suitable photocathodes for the EIC.

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