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Effect of Interfaces on the Band Gaps of InAs/GaSb Superlattices Beyond the Standard Envelope-function Approximation FRANK SZMULOWICZ, also at University of Dayton Research Institute, HEATHER HAUGAN, GAIL BROWN, Air Force Research Laboratory — We have grown several series of InAs/GaSb superlattices by molecular beam epitaxy with precisely calibrated growth rates. The superlattice parameters such as the InAs and GaSb layer widths were varied in order to produce a device with an optimum mid-infrared photoresponse and a sharpest photoresponse cut-off. The effect of design parameters on the photoresponse cut-off are explained by a nonperturbative, modified envelope function approximation (EFA) calculation that includes the interface coupling of heavy, light, and spin-orbit holes resulting from the in-plane asymmetry at InAs/GaSb interfaces. Interface effects on the EFA-calculated band structure are manifested by large band splittings and avoided crossings. The physics of these effects has been modeled analytically in several important limits. Very good agreement was found between experimental results and theory on several sets of SLs (both MWIR and LWIR) with symmetric InSb-like interfaces and mixed GaAs- and InSb-like interface. We explain the band gaps as a function of GaSb and InAs widths in terms of variations of the heavy-hole and conduction band bandwidths. Therefore, a consistent application of the EFA method with the inclusion of well established IF effects provides useful physical insights and possesses good predictive capacity in the design of NCA SLs.

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