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In-plane integration of quantum-cascade lasers with resonant intersubband nonlinearities[1] ALEXEY BELYANIN, FENG XIE, VENKATA R. CHAGANTI, DON SMITH, Texas A&M University — We have recently demonstrated that the active region of a quantum cascade laser can be integrated with a cascade of intersubband transitions designed for the intracavity nonlinear frequency conversion of laser light. Integration has been implemented in the growth direction by vertically stacking the nonlinear region and active laser stages. While this approach is easy to realize, it has limited ability to control frequency and conversion efficiency of the nonlinear signal. Here we propose in-plane integration strategy, in which the laser is divided into two separately contacted and biased sections along the cavity length. One section operates as a laser active medium while another section serves as a nonlinear element. The sections share the same layer structure but may have very different set of electron states depending on the applied biases. We show that such schemes turn out to be surprisingly flexible in implementing various optical nonlinearities. The proposed approach enables convenient and broad tuning by applied voltage and extends the room-temperature operation range of quantum cascade lasers to very short (2.5-4 μm) or very long (THz) wavelengths.

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