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ICSNN
International Conference on Superlattices, Nanostructures and Nanodevices
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Intersubband plasmon coupling enhanced current transport

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Collective excitations of electrons in quantum well structures can strongly influence intersubband transitions by many-body interactions. One kind of such an excitation is the intersubband plasmon (ISP), which is a collective charge density excitation created by the coupling of electrons from different subbands. These electron-electron interactions lead to a screening of the bare intersubband transition energy, known as the depolarization shift. When two ISPs are coupled together, interference effects can be expected that result in changes of the electrical and optical properties in such systems. We have designed a heterostructure with three subbands to investigate the coupling of an emissive and an absorptive ISP mode. The ground state and the third level are populated by current injection, while the second level is efficiently depopulated by an extraction structure. By tuning the occupation, the two ISPs can cross attractively and trapped electrons in the ground state impart enough energy from the plasma wave to be lifted up to the second subband, where they can contribute to the current. This collective effect can be directly observed as an increase of 33 percent in the current. A magnetic field applied parallel to the growth direction quantizes the in-plane dispersion into discrete Landau levels, which allows a control of the strength of the ISP coupling up to a quenching of the electron-electron interaction.

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