Micropatterned Electrostatic Trap for Indirect Excitons in Coupled GaAs Quantum Wells

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Photo-generated electron-hole pairs in quantum well devices can be manipulated in lifetime and position via a mesoscopic voltage-controlled electrostatic landscape. Whereas exciton ionization and spatial separation of electron-hole pairs by large in-plane electric fields enable us to store and release optical images at will, the quantum-confined Stark effect allows us to create long-living excitons and study their dynamics on mesoscopic length scales [1,2,3].

Here, we demonstrate a novel electrostatic trap for indirect excitons in coupled GaAs quantum wells grown in a field effect structure. The indirect excitons are trapped in the quantum wells just below edges of SiO_2-layers, which are sandwiched between the surface of the GaAs heterostructure and a semitransparent metallic top gate. We explain the exciton trapping by a local field enhancement at the edges of the SiO_2-layers in combination with the quantum confined Stark effect. We find harmonic trapping potentials with high spring constants exceeding 10 keV/cm². The electrostatically controlled confinement of such long-living excitons aims at observing the Bose-Einstein condensation of excitons [4].

We acknowledge financial support by the Center for NanoScience (CeNs), the Nanosystems Initiative Munich (NIM), and the DFG Project KO 416/17.

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