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Microwave-Induced Nonlinear Transport in Spatially Modulated 2D Electron Systems[1]

RUI-RUI DU, Rice University

We have studied experimentally the MW-induced photoresistance in a periodically modulated 2DES where a shallow triangular antidot lattice is patterned by electron-beam lithography. This work is primarily motivated by the theoretical work considering the effect of long-wavelength (>> magnetic length $l_B = \sqrt{\hbar e/B}$) disorder potentials on ZRS/ZCS, in particular, on the domain formation in this regime. Introducing an antidot lattice in a high-mobility 2DES allows for studies of scattering process in ZRS/ZCS in a more controlled fashion. Since the system is readily tunable by parameters like a(lattice constant), d (antidot diameter), and the "softness" of the antidot potential, the modulated 2DES is a rich system for studies of MIRO and ZRS. Our experiments have shown unexpected resistance features in this system. For example, we have observed resistance oscillations (periodic in B) in addition to MIRO (periodic in 1/B), which we tentatively attribute to "microwave-induced Aharonov-Bohm effect in an antidot lattice". The presence of A-B oscillations in 2DES consisting of a large number (> 200) of dots, together with the fact that such features are absent without MW irradiation, is rather remarkable. These experiments suggest the roles of edge transport and quantum interference in the MIRO. We will present a systematic study of the resistance features as a function of dot diameter, lattice constant, and the amplitude of the potential modulation. Another interesting question pertains to the effect of modulation on the ZRS, in particular, the dynamics of the domains in a periodic potential. We will report on our preliminary observations of resistance fluctuations in the ZRS in the modulated 2DES as well as that in ultrahigh mobility, unpatterned GaAs/AlGaAs quantum wells. Z. Q. Yuan et al, Phys. Rev. B 74, 075313 (2006); A. Auerbach et al, Phys. Rev. Lett. 94, 196801 (2005); I. G. Finkler and B. I. Halperin, Phys. Rev. B 79, 085315 (2009).

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