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Spin Dynamics in Semiconductor Nanostructures

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In this talk we are going to present our theoretical investigations on spin dynamics of semiconductor nanostructures under various conditions. It is shown from a fully microscopic kinetic-spin-Bloch-equation (KSBE) approach that the single-particle approach is inadequate in accounting for the spin relaxation/dephasing (R/D) both in the time domain and the spacial domain. The momentum dependence of the effective magnetic field (the Dresselhaus and the Rashba terms) and the momentum dependence of the spin diffusion rate along the spacial gradient all serve as inhomogeneous broadenings. It is pointed out that in the presence of inhomogeneous broadening, any scattering, including the carrier-carrier Coulomb scattering, can cause irreversible spin R/D. Moreover, besides the spin R/D channel the scattering provides, it also gives rise to the counter effect to the inhomogeneous broadening. The scattering tends to drive carriers to a more homogeneous states and therefore suppresses the inhomogeneous broadening. Finally, this approach is valid in both strong and weak scattering regime and can be used to study systems far away from the equilibrium such as electrons of high spin polarization and/or electrons with strong electric field (hot electrons). Many novel effects are predicted from our theory and some have been realized experimentally very recently.

Prof. Dr. M. W. Wu has been working on spin dynamics during the past 9 years. Born in 1968, Ming-Wei Wu got his Ph.D from the University of Science and Technology of China in 1995. He then worked at the Stevens Institute of Technology (US), the University of Rochester and Wilson Research Center of Xerox Corporation (US), University of Frankfurt (Germany), University of California Santa Barbara (US), and Tokyo University (Japan). He is currently professor of physics at the University of Science and Technology of China. His research activities include theoretical studies of spintronics, ultrafast spectroscopy of semiconductors, quantum kinetics, hot-electron transport, and optical and transport properties of organic materials. He is currently the Editor of Physica E (Elsevier).

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