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Investigation and direct mapping of the persistent spin helix in confined structures[1] MARKUS SCHWEMMER, MATTHIAS WEINGARTNER, ROLAND VÖLKL, MARTIN OLTSCHER, DIETER SCHUH, DOMINIQUE BOUGEARD, TOBIAS KORN, CHRISTIAN SCHÜLLER, University Regensburg

— The spin-orbit field in GaAs-based quantum well (QW) structures typically consists of two different contributions: Dresselhaus and Rashba field. The geometry of the Dresselhaus field, which arises due to the bulk inversion asymmetry, is mostly determined by the growth direction of the quantum well. The Rashba field instead is caused by a structure inversion asymmetry, which can be controlled, e.g. by the modulation doping. For the specific case of a (001)-grown GaAs quantum well with equal strength of Dresselhaus and Rashba fields, the effective spin-orbit field is oriented along the in-plane [110] direction for all k values and the spin splitting for this direction vanishes. For optically injected spins, which are initially oriented perpendicular to the QW plane, a persistent spin helix (PSH) state forms. We use a femtosecond pulsed TiSa-Laser system combined with a magneto-optical Kerr effect microscope for time- and space-resolved mapping of the PSH. With this technique, we investigate the PSH behavior in confined structures, e.g., thin channels along the helix direction. Hence we find that lateral confinement increases the effective PSH lifetime drastically. In more complex structures, we observe that PSH formation is even stable under a forced direction change.

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