Spin Hall Effect And Spin Orbit Torques

As recognized, adventure as without difficulty as experience about lesson, amusement, as without difficulty as settlement can be gotten by just checking out a books **Spin Hall Effect And Spin Orbit Torques** as a consequence it is not directly done, you could admit even more just about this life, just about the world.

We come up with the money for you this proper as with ease as simple showing off to acquire those all. We allow Spin Hall Effect And Spin Orbit Torques and numerous ebook collections from fictions to scientific research in any way. in the midst of them is this Spin Hall Effect And Spin Orbit Torques that can be your partner.

Spin Hall Effect And Spin Orbit Torques 2024-06-24

NOEMI AVILA

Chapter 5. Quantum Spin Hall State in HgTe Walter de Gruyter GmbH & Co KG

The ability to understand and control the unique properties of interfaces has created an entirely new field of magnetism, with profound impact in technology and serving as the basis for a revolution in electronics. Our understanding of the physics of magnetic nanostructures has also advanced significantly. This rapid development has generated a need for a comprehensive treatment that can serve as an introduction to the field for those entering it from diverse fields, but which will also serve as a timely overview for those already working in this area. The four-volume work Ultra-Thin Magnetic Structures aims to fulfill this dual need. The original two volumes – now available once more – are "An Introduction to the Electronic, Magnetic and Structural Properties" (Vol. I) and Measurement Techniques and Novel Magnetic Properties (this volume). Two new volumes, "Fundamentals of Nanomagnetism" and "Applications of Nanomagnetism," extend and complete this comprehensive work by presenting the foundations of spintronics.

Semiconductor Spintronics
John Wiley & Sons
Since the discovery of the giant magnetoresistance (GMR) effect in magnetic multilayers in 1988, a new branch of physics and technology, called spin-electronics or spintronics, has emerged, where the flow of electrical charge as well as the flow of electron spin, the so-called "spin current", are manipulated

and controlled together. Recent progress in the physics of magnetism and the application of spin current has progressed in tandem with the nanofabrication technology of magnets and the engineering of interfaces and thin films. This book is intended to provide an introduction and guide to the new physics and applications of spin current. The emphasis is placed on the interaction between spin and charge currents in magnetic nanostructures.

Spin Hall Effect in Two-dimensional Hole Gases
John Wiley & Sons
This book presents both experimental and theoretical aspects of topology in magnetism. It first discusses how the topology in real space is relevant for a variety of magnetic spin structures, including domain walls, vortices, skyrmions, and dynamic excitations, and then focuses on the phenomena that are driven by distinct topology in reciprocal momentum space, such as anomalous and spin Hall effects, topological insulators, and Weyl semimetals. Lastly, it examines how topology influences dynamic phenomena and excitations (such as spin waves, magnons, localized dynamic

solitons, and Majorana fermions). The book also shows how these developments promise to lead the transformative revolution of information technology. *Spin Physics in Semiconductors* Springer Science & Business Media Spintronics is an emerging technology that exploits the intrinsic spin of the electron and its associated magnetic moment in addition to its fundamental electronic charge. The central issue of this multidisciplinary field is the manipulation of the spin degree of freedom in solid-state systems. Discoveries in recent years have inspired a new route in spintronic research which needs no ferromagnetic components. The research field "spintronic without magnetism" is based on the possibility to manipulate electric currents via spin-orbit coupling only. The spin Hall effect (SHE) is one of the most promising effects for the generation of spin polarized currents which is even present in non-magnetic materials. The SHE appears when an electric current flows through a medium with spin-orbit coupling present, leading to a spin-current perpendicular to the charge current. In this work the SHE as well as the anomalous Hall effect

(AHE) are investigated on a first principles level using the spin-polarized fully relativistic Korringa-Kohn-Rostoker Green's function method (SPR-KKR-GF) in conjunction with the linear response Kubo-Streda formalism. Intrinsic as well as extrinsic contributions to the SHE/AHE are treated on equal footing. This opened up for the first time the possibility to reliably decompose the SHE/AHE into skew and side-jump scattering as well as intrinsic contributions in a quantitative manner. Relativistic Electronic Transport Theory OUP Oxford

Like its predecessor, this book by the renowned physicist Sir Rudolf Peierls draws from many diverse fields of theoretical physics to present problems in which the answer differs from what our intuition had led us to expect. In some cases an apparently convincing approximation turns out to be misleading; in others a seemingly unmanageable problem turns out to have a simple answer. Peierls's intention, however, is not to treat theoretical physics as an unpredictable game in which such surprises happen at random. Instead he shows how in each case careful thought could have prepared us for the outcome. Peierls has chosen mainly problems from his own experience or that of his collaborators, often showing how classic problems can lend themselves to new insights. His book is aimed at both graduate students and their teachers. Praise for Surprises in Theoretical Physics: "A beautiful piece of stimulating scholarship and a delight to read. Physicists of all kinds will learn a great deal from it."-- R. J. Blin-Stoyle, Contemporary Physics Nonlinear Spin-wave Excitation Detected by the Inverse Spin-Hall Effect World Scientific The purpose of this collective book is to present a non-exhaustive survey of sp-related phenomena in semiconductors with a focus on recent research. In some sense it may be regarded as an updated version of theOpticalOrientation book, which was entirely devoted to spin physics in bulk semiconductors. During the 24 years that have elapsed, we have witnessed, on the one hand, an extraordinary development in the wonderful semiconductor physics in two dim- sions with the accompanying revolutionary applications. On the other hand, during the last maybe 15 years there was a strong revival in the interest in spin phen-ena, in particular in low-dimensional semiconductor structures. While in the 1970s and 1980s the entire world population of researchers in the ?eld never exceeded 20 persons, now it can be counted by the hundreds and the number of publications by the thousands. This explosive growth is stimulated, to a large extent, by the hopes that the electron and/or nuclear spins in a semiconductor will help to accomplish the dream of factorizing large numbers by quantum computing and eventually to develop a new spin-based electronics, or “spintronics”. Whether any of this will happen or not, still remains to be seen. Anyway, these ideas have resulted in a large body of interesting and exciting research, which is a good thing by itself. The ?eld of spin physics in semiconductors is extremely rich and interesting with many spectacular effects in optics and transport.

A Model for a Fractionalized Quantum Spin Hall Effect

Elsevier

We show that the bulk Dresselhauss (k3) spin-orbit coupling term leads to an intrinsic spin-Hall effect in n-doped bulk GaAs, but without the appearance of uniform magnetization

. The spin-Hall effect in strained and unstrained bulk GaAs has been recently observed experimentally by Kato et. al. [1]. We show that the experimental result is quantitatively consistent with the intrinsic spin-Hall effect due to the Dresselhauss term, when lifetime broadening is taken into account. On the other hand, extrinsic contribution to the spin-Hall effect is several orders of magnitude smaller than the observed effect. *Geometric Spin Hall Effect of Light* Springer Science & Business Media There are only few discoveries and new technologies in physical sciences that have the potential to dramatically alter and revolutionize our electronic world. Topological insulators are one of them. The present book for the first time provides a full overview and in-depth knowledge about this hot topic in materials science and condensed matter physics. Techniques such as angle-resolved photoemission spectrometry (ARPES), advanced solid-state Nuclear Magnetic Resonance (NMR) or scanning-tunnel microscopy (STM) together with key principles of topological insulators such as spin-locked electronic

states, the Dirac point, quantum Hall effects and Majorana fermions are illuminated in individual chapters and are described in a clear and logical form. Written by an international team of experts, many of them directly involved in the very first discovery of topological insulators, the book provides the readers with the knowledge they need to understand the electronic behavior of these unique materials. Being more than a reference work, this book is essential for newcomers and advanced researchers working in the field of topological insulators.
Spin Hall Effect of Light in Semiconductors Elsevier Inc. Chapters
The past few decades of research and development in solid-state semicon ductor physics and electronics have witnessed a rapid growth in the drive to exploit quantum mechanics in the design and function of semiconductor devices. This has been fueled for instance by the remarkable advances in our ability to fabricate nanostructures such as quantum wells, quantum wires and quantum dots. Despite this contemporary focus on semiconductor "quantum devices," a principal quantum

mechanical aspect of the electron - its spin has it accounts for an added quan largely been ignored (except in as much as tum mechanical degeneracy). In recent years, however, a new paradigm of electronics based on the spin degree of freedom of the electron has begun to emerge. This field of semiconductor "spintronics" (spin transport electron ics or spin-based electronics) places electron spin rather than charge at the very center of interest. The underlying basis for this new electronics is the intimate connection between the charge and spin degrees of freedom of the electron via the Pauli principle. A crucial implication of this relationship is that spin effects can often be accessed through the orbital properties of the electron in the solid state. Examples for this are optical measurement s of the spin state based on the Faraday effect and spin-dependent transport measure ments such as giant magneto-resistance (GMR). In this manner, information can be encoded in not only the electron's charge but also in its spin state, i. e.

The Spin Hall Effect and Related Phenomena
Springer
This book honors the

remarkable science and life of Shoucheng Zhang, a condensed matter theorist known for his work on topological insulators, the quantum Hall effect, spintronics, superconductivity, and other fields. It contains the contributions displayed at the Shoucheng Zhang Memorial Workshop held on May 2-4, 2019 at Stanford University.

A New Generation of Microstructures Princeton University Press

The spin Hall effect (SHE) induced spin current in some certain heavy transition metals has been shown to impose spin transfer torque (STT) upon an adjacent magnetic layer strong enough to excite magnetization switching and/or magnetic oscillation therein. The similarities and differences between this new paradigm and the traditional route of spin generation will be the main focus of this dissertation. Firstly, these phenomena stemming from the SHE can be viewed as a reminiscent of the traditional spin-torque generation from a ferromagnetic layer in spin-valve-like devices, except that now the source of the STT is coming from the normal metal (NM) layer instead of the ferromagnetic

(FM) spin-polarizer in those traditional devices with sandwich structures (FM/NM/FM or FM/Insulator/FM). In this fashion, essentially only one layer of ferromagnetic layer is required as the read-out means. In the first part of this dissertation, I will show that this detection of the spin-Hall response can be done either via anisotropic magnetoresistance (AMR), anomalous Hall effect (AHE), or planar Hall effect (PHE) in a simple NM/FM bilayer structure. By analyzing the data from both high and low frequency measurements, the spin Hall angle, which represents the strength of the SHE, from various transition metals are estimated. Secondly, the symmetry of the SHE, from which the resulting spin current is transverse to the applied charge current, allows us to design STT devices using in-plane charge current (CIP) instead of the traditional utilization of current-perpendicular-toplane (CPP) architecture. This facilitates the realization of a new three-terminal device, which eventually leads us to a prototype of magnetic cross-point nonvolatile memory. By studying the SHE-STT switching from beta-Ta and beta-W-based three-terminal devices, I will confirm that the spin Hall angle of [beta]-Ta and [beta]-W are respectively [ALMOST EQUAL TO]-0.15 and [ALMOST EQUAL TO]-0.30, which are consistent with the results from the first part of this work. The strong SHE from these transition metals can also be adopted to modulate spin-waves and will be shown at the end of this section. Lastly, the adaptation of a CIP architecture means that the spin-charge transport properties in the spin Hall devices are, per se, more complicated than that in their CPP counterparts. The interface(s) as well as the bulk properties in these magnetic heterostructures both play important roles in determining the final spin transport properties, thereby the effective spin Hall efficiency. In this final section, I will present the variation of the current induced damping-like torque and field-like torque in NM/(spacer)/FM heterostructures, from which the possible interplay between interface(s) and bulk, as well as their relative contributions, can be estimated.

Quantum Spin Hall Effect

Springer Science & Business Media

As the first comprehensiv

e introduction into the rapidly evolving field of spintronics, this textbook covers ferromagnetism in nano-electrodes, spin injection, spin manipulation, and the practical use of these effects in next-generation electronics. Based on foundations in quantum mechanics and solid state physics this textbook guides the reader to the forefront of research and development in the field, based on repeated lectures given by the author. From the content: Low-dimensional semiconductor structures Magnetism in solids Diluted magnetic semiconductors Magnetic electrodes Spin injection Spin transistor Spin interference Spin Hall effect Quantum spin Hall effect Topological insulators Quantum computation with electron spins *Cavity Polaritons* Spin Current Volume 32 of the series addresses one of the most rapidly developing research fields in physics: microcavities. Microcavities form a base for fabrication of opto-electronic devices of XXI century, in particular polariton lasers based on a new physical principle with respect to conventional lasers proposed by Einstein in 1917. This book overviews a theory of all major phenomena linked microcavities and exciton-polaritons and is oriented to the reader having no background in solid state theory as well as to the advanced readers interested in theory of exciton-polaritons in microcavities. All major experimental discoveries in the field are addressed as well. · The book is oriented to a general reader and is easy to read for a non-specialist. · Contains an overview of the most essential effects in physics of microcavities experimentally observed and theoretically predicted during the recent decade such as:. · Bose-Einstein condensation at room temperature. · Lasers without inversion of population. · Microcavity boom: optics of the XXI century! · Frequently asked questions on microcavities and responses without formulas. · Half-light-half-matter quasi-particles: base for the future optoelectronic devices Topological Insulators CRC Press Electrical generation of spin polarization by the spin Hall effect is imaged with both spatial and temporal resolution using Kerr rotation microscopy in bulk zincblende semiconductors. The spin Hall effect, which arises due to the spin-orbit coupling, refers to the generation of a pure spin current transverse to a charge current driven by an electric field which causes a spontaneous quasi-equilibrium spin accumulation near sample boundaries without the need for magnetic fields or magnetic materials. Bulk current-induced in-plane spin polarization and out-of-plane spin accumulation from the spin Hall effect are observed in the II-VI semiconductor ZnSe despite no evidence for a spin-orbit induced internal magnetic field, which are only observed sub-critical thickness ZnSe with enhanced k-linear Hamiltonian terms due to biaxial strain. The wide band gap of ZnSe enables the first observation of electrical spin generation at room temperature. The spatial dependence of steady-state spin accumulation from the spin Hall effect is addressed in channels made of the III-V semiconductor GaAs. One- and two-dimensional spatially-resolved diffusion modeling clarifies the important role of drift and diffusion in transporting spin generated at sample boundaries to the interior of the device. Driving spin accumulation with an electrical pulse and

probing with a frequency-synchronized ultrafast laser enables time-resolved measurement of the spin Hall effect. Probing the dynamical processes of spin accumulation and diffusion reveals spatially-dependent nanosecond timescales comparable to the electric-field dependent spin coherence time. Prospects are considered for an all-electrical measurement of the spin Hall effect which should enable more accurate determination of the magnitude of the spin Hall conductivity and illuminate the microscopic mechanisms governing the spin Hall effect in GaAs. Resonant Spin Hall Effect in Two-dimensional Electron Systems OUP Oxford
Spin current is the flow of electron spin angular momentum. It can either be partially spin polarized current generated due to the exchange interactions of spins and local magnetization, or pure spin current generated from spin orbit interaction. Both sources of spin current are under intensive study for their efficient interaction with nanoscale magnetic structures, and potential application of magnetoresistive random-access memory (MRAM), spin torque nano-oscillators

(STNOs) and other innovative devices. In this dissertation, spin Hall effect mediated magnetization dynamics in Platinum/Permalloy nanowires are excited by different means and studied experimentally. This includes stead state self-oscillation of magnetization in a ferromagnetic nanowire serving as the active region of a spin torque oscillator driven by spin orbit torques. Our work demonstrate that magnetization self-oscillations can be excited in a one-dimensional magnetic system and that dimensions of the active region of spin torque oscillators, for the first time, can be extended beyond the nanometer length scale. We also demonstrate that via proper design of the nanowire shape, which results in spatial non-uniform spin current density, we can significantly decrease the phase noise of spin orbit torque oscillators. It also stabilizes the single-mode generation regime, and points out a path for partial control of multi-mode excitation in nanostructures. We also parametrically excite magnetization dynamics in the nanowires, and it demonstrates that nonlinear dynamic magnetic effect can have a larger efficiency than the direct linear excitation in spin Hall structures, and it provides additional information about excited spin wave mode systems owing to its threshold nature that is unavailable from direct excitation. *More Surprises in Theoretical Physics* Elsevier Present worldwide funding in organic electronics is poised to stimulate major research and development efforts in organic materials research for lighting, photovoltaic, and other optoelectronic applications. The field of organic spintronics, in particular, has flourished in the area of organic magneto-transport. Reflecting the main avenues of substantial advances in this arena, Organic Spintronics is an up-to-date summary of the experimental and theoretical aspects of the field. With contributions by a panel of international experts on the cutting edge of research, this volume explores: Spin injection and manipulation in organic spin valves The magnetic field effect in organic light-emitting diodes (OLEDs) The spin transport effect in relation to spin manipulation Organic magnets as

spin injection electrodes in organic spintronics devices The coherent control of spins in organic devices using the technique of electronically detected magnetic resonance The possibility of using organic spin valves as sensors Balancing practical experimentation with analytical constructs, the book covers both the theoretical aspects of spin injection, transport, and detection in organic spin valves as well as the underlying mechanism of the magnetoresistance and magneto-electroluminescence in OLEDs. The first book of its kind on this specialized area, this volume is destined to provide researchers and students with the impetus to develop new channels of inquiry in an area that has almost limitless potential.
Resonant Spin Hall Effect in Two-dimensional Electron Systems
The quantum Hall liquid is a novel state of matter with profound emergent properties such as fractional charge and statistics. Existence of the quantum Hall effect requires breaking of the time reversal symmetry caused by an external magnetic field. In this work, we predict a quantized spin Hall effect in

the absence of any magnetic field, where the intrinsic spin Hall conductance is quantized in units of 2 e/4[pi]. The degenerate quantum Landau levels are created by the spin-orbit coupling in conventional semiconductors in the presence of a strain gradient. This new state of matter has many profound correlated properties described by a topological field theory.

Semiconductor Spintronics and Quantum Computation

This book first provides the basics of magnetism that electrical engineering students in the semiconductor curriculum can easily understand. Then, it goes one step forward to discuss electron spin. Following the above background discussion, readers are taught the physics of magnetic tunnel junction device (MTJ), the work horse of MRAM, for memory applications. At the end of this book, the author gives a comparison of emerging non-volatile memories (PCM, ReRAM, FeRAM and MRAM). The author also explores MRAM's unique quality among emerging memories, in that is the only one in which the atoms in the device do not move when switching states. This property makes it the most reliable and low power.

Topology in Magnetism

This book comprises the first systematic exposition of various physical aspects of the orientation of electron and nuclear spins in semiconductors by optical means.

Spin Currents Detected Via the Inverse Spin-Hall Effect

Nowadays information technology is based on semiconductor and ferromagnetic materials. Information processing and computation are based on electron charge in semiconductor transistors and integrated circuits, and information is stored on magnetic high-density hard disks based on the physics of the electron spins. Recently, a new branch of physics and nanotechnology, called magneto-electronics, spintronics, or spin electronics, has emerged, which aims at simultaneously exploiting both the charge and the spin of electrons in the same device. A broader goal is to develop new functionality that does not exist separately in a ferromagnet or a semiconductor. The aim of this book is to present new directions in the development of spin electronics in both the basic physics and the technology which will become the foundation of future electronics.