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Paola Di Pietro

# Optical Properties of Bismuth-Based Topological Insulators



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# Optical Properties Of Bismuth Based Topological Insulators Springer Theses

**Christian Drosten**

## **Optical Properties Of Bismuth Based Topological Insulators Springer Theses:**

*Optical Properties of Bismuth-Based Topological Insulators* Paola Di Pietro, 2013-10-24 Topological Insulators TIs are insulators in the bulk but have exotic metallic states at their surfaces The topology associated with the electronic wavefunctions of these systems changes when passing from the bulk to the surface This work studies by means of infrared spectroscopy the low energy optical conductivity of Bismuth based TIs in order to identify the extrinsic charge contribution of the bulk and to separate it from the intrinsic contribution of the surface state carriers The extensive results presented in this thesis definitely shows the 2D character of the carriers in Bismuth based topological insulators The experimental apparatus and the FTIR technique the theory of optical properties and Surface Plasmon Polaritons as well as sample preparation of both crystals and thin films and the analysis procedures are thoroughly described

## **Proceedings of The 4th International**

### **Conference on Optoelectronic and Nano Materials for Advanced Technology**

Aldrin Antony, Saji K J, Priya M. J., 2025-10-25 This book includes peer reviewed articles from the 4th International Conference on Optoelectronic and Nanomaterials for Advanced Technology icONMAT 2025 held during 11-14 February in Cochin India It highlights recent advances covering a diverse range of themes including nanomaterials and devices energy harvesting and storage thin films and coatings biomaterials and engineering ultrafast laser technologies 2D materials and devices and quantum materials It presents latest developments innovative methodologies potential applications with the emphasis on solving critical challenges in energy efficiency healthcare and quantum materials synthesis By fostering technology driven solutions and interdisciplinary collaborations this collection serves as a valuable reference for researchers academicians and industry professionals working in materials science nanotechnology and advanced device engineering

## **Bismuth-Containing**

**Alloys and Nanostructures** Shumin Wang, Pengfei Lu, 2019-07-03 This book focuses on novel bismuth containing alloys and nanostructures covering a wide range of materials from semiconductors topological insulators silica optical fibers and to multiferroic materials It provides a timely overview of bismuth alloys and nanostructures from material synthesis and physical properties to device applications and also includes the latest research findings Bismuth is considered to be a sustainable and environmentally friendly element and has received increasing attention in a variety of innovative research areas in recent years The book is intended as a reference resource and textbook for graduate students and researchers working in these fields

## **Optical and electrical properties of topological insulator Bi<sub>2</sub>Se<sub>3</sub>**

Jiajun Zhu, 2017-07-12 Topological insulator is one of the hottest research topics in solid state physics This is the first book to describe the vibrational spectroscopies and electrical transport of topological insulator Bi<sub>2</sub>Se<sub>3</sub> one of the most exciting areas of research in condensed matter physics In particular attempts have been made to summarize and develop the various theories and new experimental techniques developed over years from the studies of Raman scattering infrared spectroscopy and electrical transport of topological insulator Bi<sub>2</sub>Se<sub>3</sub> It is intended for material and physics researchers and graduate students doing

research in the field of optical and electrical properties of topological insulators providing them the physical understanding and mathematical tools needed to engage research in this quickly growing field Some key topics in the emerging field of topological insulators are introduced **Topological Insulators** Inamuddin,2024-01-15 A topological insulator is an area that has yet to be fully explored and developed The charge induced bandgap fluctuation in the best known bismuth chalcogenide based topological insulators is approximately 10MeV in magnitude The major focus has shifted to the investigation of the presence of high symmetry electronic bands as well as the utilization of easily produced materials As the subject of topological insulators is still in the nascent stage there is growing research and knowledge in the emerging field This book is intended to provide the readers with an understanding of the needs and application of these materials Keywords Topological Insulators Insulators One Dimensional Topological Insulators Graphene Magnetic Topological Insulator Antiferromagnetic Phase Ferromagnetic Phase Topological Superconductor Nonlinear Optical Behavior Saturable Absorber Quantum Band Gap Photonic Topological Insulators Infrared and Optical Studies of Topological Insulators Bi<sub>2</sub>Te<sub>3</sub>, Bi<sub>2</sub>Se<sub>3</sub> and Sb<sub>2</sub>Te<sub>3</sub> Michael Scott Wolf,2011 Topological insulators are currently a main focus of condensed matter research They have a unique property in which the bulk of the material acts as an insulator while the surface states display metallic behavior Using infrared optical and magneto optical spectroscopy we have studied 3D topological insulators Bi<sub>2</sub>Se<sub>3</sub> Bi<sub>2</sub>Te<sub>3</sub> Sb<sub>2</sub>Te<sub>3</sub> to understand their optical properties The measurements were carried out using a Fourier Transform Infrared Spectrometer FTIR and an ultraviolet visible spectrometer at varying temperatures ranging from 5 Kelvin to 300 Kelvin and at varying magnetic fields up to 18 Tesla We use the Drude Lorentz model to replicate the experimental data of the samples allowing to gain an understanding of the physical phenomena happening in the infrared visible and ultraviolet regions of radiation This understanding gives us insight on the optical properties of the materials such as charge dynamics Results show that the temperature and magnetic field have an effect on the charge carriers especially near the plasma frequency

Topological Insulators Shun-Qing Shen,2013-01-11 Topological insulators are insulating in the bulk but possess metallic states present around its boundary owing to the topological origin of the band structure The metallic edge or surface states are immune to weak disorder or impurities and robust against the deformation of the system geometry This book the first of its kind on topological insulators presents a unified description of topological insulators from one to three dimensions based on the modified Dirac equation A series of solutions of the bound states near the boundary are derived and the existing conditions of these solutions are described Topological invariants and their applications to a variety of systems from one dimensional polyacetalene to two dimensional quantum spin Hall effect and p wave superconductors and three dimensional topological insulators and superconductors or superfluids are introduced helping readers to better understand this fascinating new field This book is intended for researchers and graduate students working in the field of topological insulators and related areas Shun Qing Shen is a Professor at the Department of Physics the University of Hong Kong China

**Topological Insulators** ,2013-11-23 Topological Insulators volume six in the Contemporary Concepts of Condensed Matter Series describes the recent revolution in condensed matter physics that occurred in our understanding of crystalline solids The book chronicles the work done worldwide that led to these discoveries and provides the reader with a comprehensive overview of the field Starting in 2004 theorists began to explore the effect of topology on the physics of band insulators a field previously considered well understood However the inclusion of topology brings key new elements into this old field Whereas it was thought that all band insulators are essentially equivalent the new theory predicts two distinct classes of band insulators in two spatial dimensions and 16 classes in three dimensions These topological insulators exhibit a host of unusual physical properties including topologically protected gapless surface states and exotic electromagnetic response previously thought impossible in such systems Within a short time this new state of quantum matter topological insulators has been discovered experimentally both in 2D thin film structures and in 3D crystals and alloys It appears that topological insulators are quite common in nature and there are dozens of confirmed substances that exhibit this behavior Theoretical and experimental studies of these materials are ongoing with the goal of attaining the fundamental understanding and exploiting them in future practical applications Usable as a textbook for graduate students and as a reference resource for professionals Includes the most recent discoveries and visions for future technological applications All authors are prominent in the field *The Measurement and Significance of the Optical Properties of Bismuth in the Infra-red* Arthur Hogg,1957

**A Short Course on Topological Insulators** János K. Asbóth,László Oroszlány,András Pályi,2016-02-23 This course based primer provides newcomers to the field with a concise introduction to some of the core topics in the emerging field of topological insulators The aim is to provide a basic understanding of edge states bulk topological invariants and of the bulk boundary correspondence with as simple mathematical tools as possible The present approach uses noninteracting lattice models of topological insulators building gradually on these to arrive from the simplest one dimensional case the Su Schrieffer Heeger model for polyacetylene to two dimensional time reversal invariant topological insulators the Bernevig Hughes Zhang model for HgTe In each case the discussion of simple toy models is followed by the formulation of the general arguments regarding topological insulators The only prerequisite for the reader is a working knowledge in quantum mechanics the relevant solid state physics background is provided as part of this self contained text which is complemented by end of chapter problems **Manipulation of Topological Edge States** Andreas Eich,2015-08-07 Topological insulators TIs are a class of materials which are insulating in the bulk but exhibit conductive states at the edges These states are spin polarized protected against non magnetic perturbations and exhibit a linear dispersion Due to these topological features topological insulators may decisively contribute to the construction of spintronic devices This book summarizes the results of an experimental Ph D thesis which aimed at finding methods for tailoring TIs The first part provides an introduction to the field of topological insulators and the applied measurement techniques STM

and ARPES In the second part four experiments are presented in which different strategies to tailor the edge states were exploited For the prototypical topological insulator Bi<sub>2</sub>Se<sub>3</sub> it is shown that stoichiometric variations enhance the isolation of the edge state from the bulk band structure Also for Bi<sub>2</sub>Se<sub>3</sub> a method was found to introduce magnetic atoms Fe to the vicinity of the edge state which avoids any band bending effect Furthermore it is shown how edge states can be moved away from the surface of a TI Creating a rough surface forces the edge state of TlBiSe<sub>2</sub> to shift into the bulk Finally it is shown how growing a Bi bilayer on Bi<sub>2</sub>Se<sub>3</sub> shifts the edge state further out of the TI where it interacts with bilayer states The presented experiments prove the topological nature of these edge states and its consequences The methods applied for the manipulation may allow a tailoring of topological insulators for future technological applications based on the spin degrees of freedom

**Density Functional Study of Electronic and Optical Properties of Ternary Mixed Chalcogenides**  
**Topological Insulators** ,2016      *Some Optical Properties of Bismuth Sulfide* Leroy Robert Loewenstein,1965

## **Optical Properties Of Bismuth Based Topological Insulators Springer Theses** Book Review: Unveiling the Magic of Language

In an electronic era where connections and knowledge reign supreme, the enchanting power of language has become more apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is actually remarkable. This extraordinary book, aptly titled "**Optical Properties Of Bismuth Based Topological Insulators Springer Theses**," compiled by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we shall delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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