PROCEEDINGS OF SPIE

Spintronics V

Henri-Jean Drouhin
Jean-Eric Wegrowe
Manijeh Razeghi
Editors

12–16 August 2012
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 8461

Proceedings of SPIE 0277-786X, V.8461

Spintronics V, edited by Henri-Jean Drouhin, Jean-Eric Wegrowe, Manijeh Razeghi,
Proc. of SPIE Vol. 8461, 846101 · © 2012 SPIE · CCC code: 0277-786/12/$18 · doi: 10.1117/12.2009159

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:
Author(s), "Title of Paper," in *Spintronics V*, edited by Henri-Jean Drouhin, Jean-Eric Wegrowe, Manijeh Razeghi, Proceedings of SPIE Vol. 8461 (SPIE, Bellingham, WA, 2012) Article CID Number.

ISSN: 0277-786X
ISBN: 9780819491787

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
SPIE.org

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIE Digital Library
SPIEDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B … 0Z, followed by 10-1Z, 20-2Z, etc.

The CID Number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID Number.

Contents

Conference Committee

Symposium Chairs

David L. Andrews, University of East Anglia Norwich (United Kingdom)
James G. Grote, Air Force Research Laboratory (United States)

Symposium Cochairs

Satoshi Kawata, Osaka University (Japan)
Manijeh Razeghi, Northwestern University (United States)

Conference Chairs

Henri-Jean Drouhin, Ecole Polytechnique (France)
Jean-Eric Wegrowe, Ecole Polytechnique (France)
Manijeh Razeghi, Northwestern University (United States)

Conference Program Committee

Jack Bass, Michigan State University (United States)
Franco Ciccacci, Politecnico di Milano (Italy)
Russell P. Cowburn, University of Cambridge (United Kingdom)
Vincent Cros, Unité Mixte de Physique CNRS/Thales (France)
Hanan Dery, University of Rochester (United States)
Michel I. Dyakonov, Université Montpellier 2 (France)
Michael E. Flatté, The University of Iowa (United States)
Jean-Marie George, Unité Mixte de Physique CNRS/Thales (France)
Henri Jaffrès, Unité Mixte de Physique CNRS/Thales (France)
Andrew D. Kent, New York University (United States)
Mathias Klaui, Universität Konstanz (Germany)
Yuri A. Mamaev, St. Petersburg State Polytechnical University (Russian Federation)
Ryan P. McClintock, Northwestern University (United States)
Laurens W. Molenkamp, Julius-Maximilians- Universität Würzburg (Germany)
Hiro Munekata, Tokyo Institute of Technology (Japan)
Yoshichika Otani, The University of Tokyo (Japan)
Dafiné Ravelosona, Institut d'Électronique Fondamentale (France)
Nitin Samarth, The Pennsylvania State University (United States)
Alain Schuhl, Commissariat à l'Énergie Atomique (France)
Jing Shi, University of California, Riverside (United States)
Donald J. Silversmith, Defense Threat Reduction Agency (United States)

Luc Thomas, IBM Almaden Research Center (United States)
Evgeny Tsymbal, University of Nebraska-Lincoln (United States)
Olaf M. J. van 't Erve, U.S. Naval Research Laboratory (United States)
Joerg Wunderlich, Hitachi Cambridge Laboratory (United Kingdom)
Igor Zutic, University at Buffalo (United States)

Session Chairs

1 Spin Coherence, Dynamics, and Fluctuation
Jean-Eric Wegrowe, Ecole Polytechnique (France)

2 Spin-Injection I
Aurelie M. Spiesser, National Institute of Advanced Industrial Science and Technology (Japan)

3 Spin-Injection II
Junsaku Nitta, Tohoku University (Japan)

4 Spin-Injection III
Yuichiro Ando, Osaka University (Japan)

5 Magnetic Tunnel Junction
Jean-Marie George, Unité Mixte de Physique CNRS/Thales (France)

6 Spin-Orbit Interaction
Shoji Ikeda, Tohoku University (Japan)

7 Spin Transfer
Christian Binek, University of Nebraska-Lincoln (United States)

8 Nanomagnetism
Yves Acremann, ETH Zürich (Switzerland)

9 Voltage Control
Marius Vasile Costache, Institut Català de Nanotecnologia (Spain)

10 Magnetic SC, Multiferoics, and Graphene
Luc Thomas, IBM Almaden Research Center (United States)

11 Spin-Optics I
Henri-Jean Drouhin, Ecole Polytechnique (France)

12 Spin Caloritronics
Jean-Eric Wegrowe, Ecole Polytechnique (France)

13 Spin-Optics II
Erez Hasman, Technion-Israel Institute of Technology (Israel)

14 Spin-Optics and Optoelectronics
Qiwen Zhan, University of Dayton (United States)

15 Fundamental Properties of Materials
Igor Zutic, University at Buffalo (United States)

16 Optical Methods and Devices
Michael Oestreich, Leibniz Universität Hannover (Germany)

Introduction

The fifth edition of the Spintronics symposium of the SPIE conference gathered more than sixty five speakers in San Diego from Sunday 12 to Thursday 16 August 2012.

As for the four previous editions, the symposium covered the main topics of Spintronics, witnessing for the dynamism of a very active field of research. These proceedings report some important results presented at the meeting.

The fourteen sessions covered: Spin Coherence, Spin Injection (three sessions), Magnetic Tunnel Junctions, Spin-Orbit Interaction, Spin-Transfer, Nanomagnetism, Voltage Controlled Magnetism, Magnetic Semiconductors, Multiferroics and Graphene, Spin-Optics (two sessions), Spin Caloritronics, Spin-Optics and Optoelectronics, Fundamental Properties of Materials, and Optical Methods and Devices.

This symposium was an opportunity to focus on the hot topics of Spin Caloritronics, Voltage Controlled Magnetism, and Spin-Optics.

This year, for the first time, three sessions were devoted to the emerging field of spin optics, where effects related to the photon spin are observed on the propagation of light beams, e.g. optical Spin Hall Effect, in analogy to spintronics experiments based on the electron spin. These spin optics sessions, introduced by a keynote presentation by Erez Hasman (see proceedings), allowed a stimulating matching with other conferences focused on photonics and were an opportunity for exciting discussions and cross-fertilization.

Overall, the conference was an invaluable opportunity for open exchange and stimulating discussions in a friendly atmosphere.

We are grateful to SPIE, to the Program Committee, and to all speakers and authors that have made this conference a success.

Henri-Jean Drouhin
Jean-Eric Wegrowe
Manijeh Razeghi