Functional Two-Dimensional Layered Materials—From Graphene to Topological Insulators

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Functional Two-Dimensional Layered Materials—From Graphene to Topological Insulators

Symposium held April 25–29, 2011, San Francisco, California, U.S.A.

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TOPOLOGICAL INSULATORS AND QUASI-2D MATERIALS

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PREFACE

Two-dimensional (2D) layered materials attract growing interest in both fundamental science and technology. The most known 2D material – graphene – reveals excellent electronic, mechanical, and thermal properties. It was proposed for applications in transparent electrodes, sensing and advanced electron microscopy, energy conversion and storage, thermal management and high-frequency communication applications. Other 2D materials, quasi-2D crystals and molecular monolayers are also gaining visibility. One of the examples is quintuples or few-quintuple layers of bismuth telluride family of materials, which were identified as topological insulators. Topological insulators and graphene are related via Dirac type of electron dispersion.

Symposium Y, "Functional Two-Dimensional Layered Materials", at the 2011 MRS Spring Meeting in San Francisco, California, April 25-29 was the first MRS symposium which combined together graphene, topological insulator thin films, other 2D and quasi-2D materials aimed to highlight breakthroughs, progress, and challenges in the synthesis, processing, structure, and assembly of 2D layered materials, and how these factors affect their properties and applications. The session topics included: (i) materials synthesis and processing (physical and chemical approaches, top-down and bottom-up; control of size, shape, and conformation of the 2D sheets; processing and assembly, patterning and integration into device structures); (ii) structure and characterization (microscopy, spectroscopy, theory and simulation); (iii) physical and chemical properties (optical, electronic, thermal, magnetic, and mechanical properties; surface modification; chemical and photochemical reactivity); (iv) electronic, thermal management and energy applications (electron and phonon transport; thermal properties; composites, hybrid materials, catalytic, energy, and biological applications); (v) topological insulators and non-carbon 2D materials.

Among the invited speakers who took part in the symposium were such recognized experts in the field as Professor Pulickel Ajayan (Rice University), Professor Ilhan Aksay (Princeton University), Dr. Phaedon Avouris (IBM T.J. Watson Research Center), Professor Manish Chhowalla (Rutgers University), Professor Jonathan Coleman (Trinity College Dublin, Ireland), Professor Yi Cui (Stanford University), Dr. Andrea Ferrari (University of Cambridge, United Kingdom), Dr. Suchismita Ghosh (Intel Corporation), Professor Robert Haddon (University of California, Riverside), Professor Mark Hersam (Northwestern University), Professor Richard Kaner (University of California, Los Angeles), Professor Philip Kim (Columbia University), Professor Sang Ouk Kim (Korea Advanced Institute of Science and Technology), Professor Roger Lake (University of California, Riverside), Dr. Jun Liu (Pacific Northwest National Laboratory), Professor Kian-Ping Loh (National University of Singapore), Professor Son Binh Nguyen (Northwestern University), Professor Elena Obraztsova (General Physics Institute, Russian Academy of Sciences, Moscow), Professor Rodney Ruoff (University of Texas, Austin), Professor James Tour (Rice University), Professor Jinlong Yang (University of Science and Technology of China), Professor Alex Zettl (University of California, Berkeley), and Professor Hua Zhang (Nanyang Technological University, Singapore).

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Symposium Y was attended by a large number of graduate students who gave talks and presented posters. Some of their outstanding work and presentations have been recognized by the MRS awards. For example, an electrical engineering PhD candidate Desalegne Teweldebrhan, who conducts his research in Professor Balandin's Nano-Device Laboratory at the University of California – Riverside, received the MRS Graduate Student Silver Award for his work on tuning of graphene properties via controlled exposure to electron beam irradiation. Jaemyung Kim, a PhD candidate from Professor Jiaxing Huang's group in the Materials Science and Engineering Department at Northwestern University also received the MRS Graduate Student Silver Award for developing the fluorescence quenching microscopy (FQM) technique for seeing graphene-based sheets, and revealing the surfactant-like behaviors of graphene oxide. In addition, Dr. Hisato Yamaguchi from Professor Manish Chhowalla' group in the Department of Materials Science and Engineering at Rutgers, The State University of New Jersey, received a Best Poster Award for his poster "Field Emission from Atomically Thin Edges of Reduced Graphene Oxide".

Symposium Y also created Symposium Young Investigator Awards to recognize the outstanding presentations given by students and postdocs. The winners were determined by voting of several symposium organizers and invited speakers. The winners of the Symposium's first place awards were Guangyu Xu, Laura J. Cote, Long Ju, Guanxiong Liu, and Vincent C. Tung. The second place award recipients were Shu Nie, Craig M. Nolen, Yu-Ying Lee, Tae Hee Han, and Owen Compton. The third place awards went to Zhong Yan, Zahid Hossain, Jie Yu, Shirui Guo, Shaahin Amini, Javed Khan, and Jiayan Luo. Other students and postdocs received a copy of the DVD "NOVA: Making Stuff" as a souvenir. The Symposium Y awards and souvenirs were sponsored by Materials Today – Elsevier, Princeton Instruments, and Cambridge NanoTech.

This volume presents a selection of papers, presented at the MRS Symposium Y, "Functional Two-Dimensional Layered Materials", which were submitted for publication. It provides an overview of the research topics and possible applications of the 2D materials and related systems. A number of the Symposium Y award winning papers, presented by the graduate students and postdoctoral researchers, are among those included in the volume. We hope that the volume will be interesting and stimulating for a wide audience.

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