U.S. Office of Naval Research, International Field Office

International Workshop on Multifunctional Materials

F. M. Pestorius
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Research International Field Offices (ONRIFO).
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Keywords

Ferroelectrics, spintronics, quantum computing, quantum Dots, wide bandgap materials, semiconductor hybrids, shape memory alloys, magnetics

1. Introduction

The Office of Naval Research (ONR) and the ONR International Field Office (ONRIFO) sponsored the International Workshop on Multifunctional Materials during the period 27-31 October 2002. The workshop was held in the Chilean resort town of Pucon. Pucon is located in the Chilean Lake District about 700 km south of the capital, Santiago. The remote location served to keep workshop attendance constant throughout its four days. Forty-seven people attended the workshop from eight countries. Over half the participants were from the US. The workshop attempted to cover the very broad subject of multifunctional materials in a format that allotted each speaker twenty minutes split between presentation and question and answer. There was ample time outside the formal presentation periods for discussion and exploration of collaboration opportunities.

The workshop was organized in 9 sessions spread over three days with a concluding breakfast session on 31 October. Each presenter was allotted twenty minutes and a limit of seven viewgraphs. The idea was that ten minutes would be devoted to presentation and the balance of each person's period to discussion. In general this format worked very well. Additionally, the local area offered a wealth of recreational and scenic activities. Trips to a thermal spring, lava tube at the Villarrica volcano, waterfalls and the lakes provided an excellent opportunity for protracted discussion and comparison of data and results. The meeting participants took excellent advantage of these opportunities. The following sections list the authors and papers. Further information is available from the author of this report at <mpestorius@onrifo.navy.mil>.

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2. Ferroelectrics

Darrel Schlom, Penn State University, Material Science and Engineering, "Integration of ferroelectric and ferromagnetic oxides with silicon by molecular beam epitaxy".

Alejandro Cabrera, Pontificia Universidad Catolica de Chile, Physics Department, "Ferroelectric oxides: a novel material for gas separation".

Raghvendra Kumar Pandey, University of Alabama Dept. of Electrical and Computer Engineering, "Limenite-Hematite: A magnetic semiconductor ferroelectric material for spintronic and microelectronic devices".

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3. **Charge and spin transport in low dimensional nanostructures**

Klaus Ensslin, ETH Zurich, “Orbital and spin effects in quantum rings”.

Enrique Anda, Pontificia Universidad Catolica de Chile, Physics Department, “Mesoscopic transport in highly correlated systems”.

David Lederman, West Virginia University, Physics Department, “Magnetic nanostructures, spin injection and sensor applications”.

Aubrey Hanbricki, Naval Research Laboratory, code 6340 Material Physics Branch, “ Electrical spin injection from Fe into GaAs/AlGaAs heterostructures”.

Gilberto Medeiros Ribeiro, Laboratorio Nacional de Luz Sincrotron, Brazil, Spin properties of S-state electrons trapped in InAs quantum dots”.

4. Optoelectronic functionality in heterostructures

Brian Moeckly, Materials Technology Group, Conductus, Sunnyvale, CA. “Integration of High temperature superconducting thin film interconnects with high-speed optoelectronic devices”.

Alejandro Fainstein, Centro Atomico Bariloche and Instituto Balseiro, Bariloche, Argentina, “Confined acoustical phonons generated and studied using microcavity confined photons”.

Isaac Hernandez-Calderon, CINVESTAV, Physics department, Mexico, “Growth and characterization of ultra-thin quantum wells of II-VI semiconductors for optoelectronic applications”.

Jiming Bao, University of Michigan, Physics department, “Optical generation of many spin-entangled states in a quantum well”.

Pablo Tamborenea, universidad de Buenos Aires, Departmento de Fisica, “Electron spin relaxation in zincblende semiconductors”.

Keith Nelson, MIT, “terahertz polaritronics: an integrated multifunctional platform”.

Aron Pinczuk, Columbia University----Paper withdraw

5. **Optically active quantum dots.**

David Gershoni, Technion, Israel, “Semiconductor quantum dots as slources of temporally and polarization correlated multicolor photons”.

Pawel Hawrylak, National Research Council of Canada “Manipulating charge and spin of single electrons and polarization of single photons in quantum dots”.

Joe Tischler, NRL, US, “Optically controlled magnetic nanostructures”.
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6. Nanoparticles

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Patricio Vargas Cantin, Universidad Tecnica Federico Santa Maria, Departmento de Fisica, Valparaiso, Chile, “ Magnetic phase diagram of nanosized systems”.

Vladimir Shalaev, Purdue University, US, “Plasmonic nanophotonics: manipulating light and sensing molecules”.

Francisco Claro, Pontificia Universidad Catolica de Chile, Physics Department, “ Terahertz detectors in the nanoscopic range”.

Sergio Ullao, Ohio University, paper withdrawn.

7. Wide Band Gap Based Multifunctional Materials

Alan Doolittle, Georgia Tech, US, “Crystalline Oxides on wide abndgap semiconductors: A novel platform for multifunctional materials integration and devices”.

Tom Myers, University of West Virginis , US, “ Considerations for epitaxial growth of multifunctional materials on GaN”

Mike Spencer, Cornell University, US "The use of scanning Kelvin probe to characterize passivated and unpassivated AlGaN/GaN heterostructure materials and devices"

Xiaixing Xi, Penn State University, US, "Epitaxial Multifunctional heterostructures consisting of borides".

8. **Multifunctional actuators**.

Chang-Beom Eom, University of Wisconsin, US, "Giant piezoelectric response in epitaxial $67Pb(Mg_{⅓}Nb_{⅔})O_3$-$33PbTiO_3$ heterostructures on silicon for high performance electromechanical systems".

Hugo Schmidt, Montana State University, US, " Photostrictive effect in polar ceramics and crystals".

Chris Palmstrøm, University on Minnesota, US, "Thin film epitaxial Heusler alloys: multifunctional materials".

9. **Semiconductor hybrids**

Harald Scheel, Technische Universitat Berlin, Germany, "Interplay between type-II superconductor and 2D electron gas in hybrid structures".

Laura Steren, Centro Atomico Bariloche and Instituto Balseiro, Bariloche, Argentina, "Interlayer coupling and magnetic anisotropies of ferromagnetic/semiconductor heterostructures".

Katherine Ziemer, Northeastern University, US, "Interface analysis and manipulation for thin film ferromagnetic/semiconductor deposition".

Boldizsar Janko, Notre Dame University, US, "Zeeman localization of spin polarized states in permalloy-magnetic semiconductor hybrids".

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10. Ferromagnetic semiconductors

Bruce Wessels, Northwestern University, US, "High temperature ferromagnetic semiconductors for spintronics".

John Ketterson, Northwestern University, US, "Novel magnetic semiconductors".

Bruce McCombe, University of Buffalo, US, “ferromagnetism in GaAs/Mn and GaSb/Mn digital alloys”.

12. Assessment

This workshop was a meeting of specialists and covered a wide range of subject matter. As a consequence, everyone at the meeting was exposed to both familiar and unfamiliar material. In general, the technical level of the presentations was high and the question periods were lively and thought provoking. The remote location of the meeting proved to be a very positive factor. Outside distraction was minimized and the participants had time to interact in a relaxed and productive environment. While the idea of navy support to research is routine in the US, it is anything but routine in Latin America and, in fact, most Latin American academics view their militaries with some suspicion and resentment. The presence of two Chilean navy officers throughout the workshop was noted in the final wrap-up session as a hopeful sign that the void between academics and the navy in Chile may be narrowing. The entry of ONR into Latin America was also generally applauded by the meeting attendees and this workshop was a good first effort by the new ONRIFO LA office. Copies of the abstracts for the meeting presentations and a complete list of meeting attendees are available from mpestorius@onrifo.navy.mil

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