
Proceedings of the
9th Latin American
Congress

**SURFACE SCIENCE
AND ITS
APPLICATIONS**

La Habana, Cuba 5 – 9 July 1999

Editors

Osvaldo de Melo

*Physics Faculty – IMRE, University of Havana
Cuba*

Isaac Hernández-Calderón

*Department of Physics, Center for Research
and Advanced Studies – IPN
Mexico*



World Scientific

Singapore • New Jersey • London • Hong Kong

Published by

World Scientific Publishing Co. Pte. Ltd.

P O Box 128, Farrer Road, Singapore 912805

USA office: Suite 1B, 1060 Main Street, River Edge, NJ 07661

UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

SURFACE SCIENCE AND ITS APPLICATIONS

Proceedings of the 9th Latin American Congress

Copyright © 2000 by World Scientific Publishing Co. Pte. Ltd.

All rights reserved. This book, or parts thereof, may not be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or any information storage and retrieval system now known or to be invented, without written permission from the Publisher.

For photocopying of material in this volume, please pay a copying fee through the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. In this case permission to photocopy is not required from the publisher.

ISBN 981-02-4396-0

Printed in Singapore.

**SURFACE SCIENCE
AND ITS
APPLICATIONS**

CLACSA- 9

Havana, July 5- 9, 1999

ORGANIZING COMMITTEES

Osvaldo de Melo (Cuba), President

INTERNATIONAL

Isaac Hernández-Calderón (Mexico), Fernando Ponce (USA), José Araya (Costa Rica), Pedro Prieto (Colombia), Blas Alacio (Argentina), Fernando Alvarez (Brazil), Miguel Kiwi (Chile), María Tamargo (USA), Jairo Giraldo (Colombia), Francisco Claro (Chile), Hernán Galindo (Venezuela), Felipe Rábago (Mexico)

LOCAL

Luis Hernández García (Physics Faculty, University of Havana), Juan Fuentes Betancourt (Institute of Materials and Reagents, University of Havana), María Sánchez Colina (Physics Faculty, University of Havana), Erick Larramendi (Physics Faculty, University of Havana), Gisela Consuegra (Institute of Materials and Reagents, University of Havana), Odalys González (Physics Faculty, University of Havana), Carlos González Raña (Physics Faculty, University of Havana)

INTERNATIONAL ADVISORY COMMITTEE

Adolfo Eguiluz (USA), Belita Khoiler (Brazil), Boris Chornik (Chile), Carlos Trallero (Cuba), Cylon Goncalves (Brazil), Eduardo Lombardo, (Argentina), Edwin Pedrero (Cuba), Fabrizio Leccabue (Italy), Fernando Briones (Spain), Fernando Cerdeira (Brazil), José L. Sánchez (Cuba), Julio Mendoza (Mexico) Leonel Cota (Mexico), Manfred Horn (Peru), Manuel Cardona (Germany), Tomás López Ríos (France), Vicente Muñoz (Spain), Walter Estrada (Perú)

SLACS Board of Directors (1997- 1999)

Isaac Hernández-Calderón (México), President
Fernando Ponce (USA)
Pedro Prieto (Colombia)
José Araya (Costa Rica)
Osvaldo de Melo (Cuba)

SLACS Board of Directors (1999- 2001)

José Araya (Costa Rica), President
Isaac Hernández- Calderón (Mexico), Past President
Fernando Ponce (USA), President CLACSA X
Osvaldo de Melo (Cuba), Past President CLACSA
Román Castro (Mexico)
Jairo Giraldo (Colombia)
Celso Aldao (Argentina)

*¿Acaso ruedan sobre los cristales, cual gotas de lluvia que quieren pasar?
¿Acaso nunca vuelven a ser algo? ¿acaso se van?
¿Y a dónde van? ¿A dónde van?*

*Silvio Rodríguez,
¿A dónde van?*

Preface

The IX Latin American Congress on Surface Science and its Applications (CLACSA - 9) was the successor of a series of meetings begun in 1980. Until 1992 they were called Latin American Surfaces Physics Symposia (SLAFS). After 1994 (Cancun, Mexico) they were called Latin American Congress of Surfaces Sciences and their Applications (CLACSA). This is one of the scientific meetings most expected and attended in Latin America. The previous congresses were: SLAFS - 1 (Brazil, 1980); SLAFS - 2 (Mexico, 1982); SLAFS - 3 (Costa Rica, 1984), SLAFS - 4 (Venezuela, 1986), SLAFS - 5 (Colombia, 1988), SLAFS - 6 (Peru, 1990); SLAFS - 7 (Argentina, 1992); Clacs - 8 (Mexico, 1994). The meetings are organized by the Latin American Society for Surface Science, Vacuum and their Applications (SLACS). The creation of the SLACS was approved in the General Meeting of SLAFS- 6 in Cusco and was established during SLAFS- 7 in Bariloche. Some of the objectives of the society are the promotion of the scientific and technological development of the Latin American region through the diffusion of surface science, vacuum, and their applications, and the establishment of cooperative efforts among research groups or institutions.

CLACSA-9 was held on 5- 9 July 1999 in the Riviera Hotel of La Habana, Cuba. It attracted more than 150 researchers from 16 countries, mostly from Latin America. The program of the congress included plenary and invited conferences and oral and poster sessions. It was organized by symposia that included the following topics: electronic and structural properties, modeling, imaging and analysis of surfaces and interfaces; low dimensional and mesoscopic systems; superconductivity, magnetism and ferroelectricity in thin films; growth, characterization and applications of thin films and coatings; vacuum, cryogenics and instrumentation; corrosion and catalysis; surfaces and interfaces in biological systems and biomaterials; interaction of molecules , atoms and ions with surfaces.

The meeting was sponsored by the University of Havana, the Abdus Salam International Centre for Theoretical Physics (ICTP), the Latin American Centre of Physics (CLAF), the National Polytechnic Institute (IPN, Mexico), the Center for Research and Advanced

Studies (CINVESTAV, Mexico). These proceedings were partially supported by the Consejo Nacional de Ciencia y Tecnología (Conacyt) of Mexico.

There was a very enthusiastic participation in the poster and oral sessions. Hotel Havana Riviera in the coast of La Habana was a good place to promote informal discussions and new liaisons. In the General Assembly it was decided that the next CLACSA will held in San José de Costa Rica in July, 2001.

Social activities were enjoyed by the participants. In the traditional "talent show" (organized by O. Arés and J. C. Drake) the participants presented artistic performances including dancing, music and humor. The excursion to Varadero beach (during the very warm Friday) was an occasion to enjoy its transparent water and fine and white sand. Finally, the typical Cuban banquet offered to the attendants the flavors of the "tamal en cazuela", the "chatinos" and the typical roasted pork meat.

The editors want to acknowledge the help of E. Larramendi in the preparation of the book.

*O. de Melo, Havana
I. Hernández- Calderón, Mexico City*

CONTENTS

CATALYTIC PHENOMENA

Palladium-Catalysis Acetylene Cyclotrimerization: from Ultrahigh Vacuum to High-Pressure Catalysts <i>D. Stacchiola, H. Molero and W. T. Tysoe</i>	3
Microstructural and Electrical Characterization of WO_x/ZrO_2 System <i>E. Torres, A. Pelaiz, F. Calderon and G. A. Fuentes</i>	17
Characterization of Copper Ion State in Mordenites with Different $\text{SiO}_2/\text{Al}_2\text{O}_3$ Molar Ratio <i>V. Petranovskii, M. Farias, N. Bogdanchikova, A. M. Martines, M. Del Valle, G. Antoshin and E. Stoyanov</i>	20
Reduction of Nickel Ions in Mordenites with Different $\text{SiO}_2/\text{Al}_2\text{O}_3$ Molar Ratio <i>V. Petranovskii, J. Cruz, A. B. Pacheco and E. Stoyanov</i>	23

ELECTRONIC AND STRUCTURAL PROPERTIES, MODELING, IMAGING AND ANALYSIS OF SURFACES AND INTERFACES

The Initial Stages of Si and C Atom Deposition on SiC Surfaces Studied Via Molecular Dynamics Simulations <i>D. R. Alfonso and S. E. Ulloa</i>	29
Submonolayer Growth and Spontaneous Halogen Etching in Si(100) <i>C. M. Aldao</i>	39
Heteroepitaxy in Highly Mismatched Systems Studied by Atomic Force Microscopy <i>G. Padeletti</i>	47
LEED – MEED Transition Induced with Temperature <i>M. A. V. Alvarez, H. Ascolani, G. Zampieri and J. Ferrón</i>	57

Surface Effects in the Optical Properties of Small Metal Particles <i>F. Valencia and J. Giraldo</i>	64
Structural Transformations of TiB ₂ -GaAs Interface At Short-Term Thermal Treatments <i>T. G. Kryshchab, J. P. Gomez, P. M. Lytvyn, O. S. Lytvyn and M. O. Mazin</i>	74
A Study of the MoO ₃ Surface with AES and EELFS <i>J. L. Carelli, G. Benitez, L. Viscido and J. M. Heras</i>	77
Crystallization Simulation in Macromolecular Crystals <i>C. M. Falcón, F. L. Falcón, S. Aguilera, R. Mulet, G. Alfonso</i>	80
Influence of Strength of Zeolite Acid Sites on Silver Cluster Stability <i>N. Bogdanchikova, V. Petranovskii, S. Fuentes, N. Katada and Y. Sugi</i>	83
Stabilization of Silver Cluster in SAPO-34 Molecular Sieves <i>N. Bogdanchikova, V. Petranovskii, M. Avalos-Borja, M. Prakash, L. Kevan and A. Quiróz S.</i>	86
Effect of Deep Traps at the Interlayer Interfaces on the Characteristics of Thin-Film GaAs Devices <i>E. Prokhorov, J. González-Hernández, N. B. Gorev, I. F. Kodzhespirova and Yu. A. Kovalenko</i>	89
Analysis of vibrationally decoupled modes of N-fold rings on SiO ₂ Glasses Films <i>F. Ruiz, J. R. Martínez and J. González-Hernández</i>	92
Surface Chiro Waves in Semiconductors <i>H. Torres-Silva</i>	95
Analysis of the Dispersion of Organic Dyes Trapped in Silica Films by the Sol Gel Method <i>J. R. Martínez, F. Ruiz and J. González-Hernández</i>	98

Formation of Localized Electronic States in a Finite Superlattice <i>R. Sagredo-Hernández and D. A. Contreras-Solorio</i>	101
Unoccupied Electronic States in Au(113): An Inverse Photoemission Study <i>W. Ibañez, P. Häberle and P. Vargas</i>	104
A Calculation of the Spectral Response on Photoconductor Thin Films of CdS Including Grain Boundary Effects <i>J. C. Giraldo and J. M. Florez</i>	107
Morphology and Chemical Composition of Hard-to-Process Microparticles in Poly(Vinyl Chloride) Films as Revealed by Scanning Electron Microscopy, Energy Dispersive X-Ray Spectrometry and Back-Scattered Electron Measurements <i>C. De La Cruz, J. Reverol, R. Quintero-Arcaya and M. Ogura</i>	110
A Calculation for Thermoelectric Power on Finite Polycrystalline Semiconductor Materials <i>J. M. Florez, C. E. Jacome, G. Gordillo and Y. G. Gurevich</i>	113
An Alternative Interpretation of the Meyer-Neldel Rule in Lead Sulfide Polycrystalline Thin Films <i>E. M. Larramendi, A. González Arias, O. Calzadilla and J. Kasaneva</i>	116
Anomalous Photoconductivity in Lead Sulfide Polycrystalline Thin Films <i>E. M. Larramendi, A. González Arias, O. Calzadilla and J. Kasaneva</i>	119
PLZT Ferroelectric Ceramic: Characterization as Possible Pyroelectric Sensors <i>A. P. Barranco, F. C. Piñar, I. G. Carmenate, O. P. Martínez and E. A. González</i>	122
Adsorption and Collective Diffusion of Adsorbed Particles on Correlated Heterogeneous One-Dimensional Substrates <i>A. J. Ramirez-Pastor, F. Bulnes and V. Pereyra</i>	125
Influence of Surface Stress on Reconstruction Processes Analytical Study and Simulaton by Monte Carlo Method <i>P. A. Velasco and J. L. Rezzano</i>	128

GROWTH, CHARACTERIZATION AND APPLICATIONS OF THIN FILMS AND COATINGS

Photon-Induced Localization and Correlation Effects in Optically Absorbing Materials	133
<i>D. E. Aspnes, K. A. Bell, L. Mantese and U. Rossow</i>	
Nonlinear and Nonequilibrium Heat and Electric Transport in Semiconductors: Characterization and Applications For Thin Films	143
<i>O. Yu. Titov, G. Espejo, Yu. G. Gurevich, A. Meriuts and G. N. Logvinov</i>	
Behavior as Photoelectrodes of TiO ₂ Thin Films Obtained Using Microwave Deposition (MWD)	146
<i>E. Vigil, I. Zumeta, R. Espinosa, C. Nuñez, J. A. Ayllón, L. Saadoun, X. Doménech and R. Rodríguez-Clemente</i>	
Wide BandGap II-VI Materials for Red-Green-Blue Emitters	156
<i>M. C. Tamargo, W. Lin, S. P. Guo, Y. Y. Luo, O. Maksimov, G. Guo and Y. C. Chen</i>	
Persistent Photoconductivity in II-VI Semiconductors	164
<i>L. Hernández, Z. Rivera-Alvarez, O. Zelaya-Angel and I. Hernández-Calderón</i>	
ZnTe Films Grown by Isothermal Closed Space sublimation and Epitaxy (ICSSE) on GaAs substrates	175
<i>O. de Melo, L. C. Hernández, L. Hernández, M. Sánchez, R. Peña-Sierra, G. Romero-Paredes and E. Larramendi</i>	
Hall Effect in Quasi-Crystalline AlCr Thin Films	178
<i>A. Sáenz and V. Castaño</i>	
ZnS Films Grown by Chemical Bath Technique on Single Crystal Substrates	181
<i>J. Vidal, O. Vigil, N. López, O. Zelaya-Angel and O. de Melo</i>	
AES Study of Cd _{1-x} Zn _x Te System Grown by Cvt-Fe Technique	184
<i>W. Cauich, P. Bartolo-Perez, R. Castro-Rodriguez, F. Caballero-Briones, M. Zapata-Torres and J. L. Peña</i>	

Cds Films Growth on Different Roughness Ito Substrates <i>A. I. Oliva, R. Castro-Rodriguez, O. Ceh and F. Caballero-Briones</i>	187
Gettering Effects of Aluminum Upon the Electrical and Transport Properties of n+-p-p+ Silicon Solar Cells <i>G. Santana, A. Morales-Acevedo, A. Martel and L. Hernández</i>	190
Properties of Undoped and Indium Doped ZnO Thin Films Deposited by Spray Pyrolysis <i>I. Pérez-Quintana, L. Hernández, A. Sánchez-Juárez and A. Tiburcio-Silver</i>	193
Nitrogen Incorporation to CdTe Thin Films Grown by Rf Sputtering in Ar-NH ₃ Plasma <i>F. Caballero-Briones, R. Castro-Rodríguez, P. Bartolo-Pérez, W. Cauich and J. L. Peña</i>	196
Determination of the Trap Density in Polycrystalline CdTe Films From Optical Absorption Profiles <i>A. Iribarren</i>	199
Structural and Photoelectric Properties of PbS Thin Films Deposited from Chemical Bath in Presence of a Magnetic Field <i>E. M. Larramendi, A. González Arias, O. Calzadilla, F. Rábago and J. Ruiz</i>	202
Photoluminescence Spectroscopy on LPCVD Silicon Oxynitride Thin Films <i>A. Morales-Acevedo, J. Castillo-Lopez, M. Aceves, G. Contreras and C. Mejía-García</i>	205
Influence of Thiourea Concentration, Deposition Temperature and Magnetic Field on the Properties of CdS Thin Films Chemically Deposited <i>Y. Rodríguez-Lazcano, O. Vigil, F. Cruz and A. Arias-Carbajal</i>	208
Optical Properties of Hydrogenated Palladium Coated Gadolinium and Dysprosium Films <i>D. E. Azofeifa, N. Clark and J. Araya Pochet</i>	211

Ethanol Gas Detector Using Zinc-Oxide-Based Coatings <i>J. Morales, J. L. Solis and W. Estrada</i>	214
Infrared Spectroscopy and Optical Properties of LPCVD Silicon Oxynitride Thin Films <i>J. Carrillo-Lopez, A. Morales-Acevedo, W. Calleja-Arriaga and E. Diaz-Valdes</i>	217
Infrared Response of Semiconductor Superlattices: 45° Reflectometry <i>A. Silva-Castillo and F. Pérez-Rodríguez</i>	220
Damage of MBE Grown CaF ₂ Thin Films after Electron Beam Irradiation Studied by Rheed, AES and RBS <i>A. Zehe, I. Becerra and A. Ramírez</i>	223
Single Crystalline Aluminium Thin Film Growth on Si(111) by MBE: A RHEED Study <i>A. Zehe, A. Ramírez and A. Thomas</i>	226
Study and Characterization of Zn _x Cd _{1-x} O Thin Films Obtained by Spray Pyrolysis Technique <i>L. Vaillant, G. Santana, O. Vigil, F. Grobart, F. Cruz, A. Morales-Acevedo and G. Contreras-Puente</i>	230
Different TiO ₂ Mesoporous Powders Used For the Preparation of Photoelectrodes <i>I. Zumeta, R. Espinosa, C. Nuñez, E. Vigil, J. A. Ayllón, L. Saadoun, X. Doménech and R. Rodríguez-Clemente</i>	233
Electrical Transport Properties Study on CdS Thin Films Through Thermoelectric Power Measurements <i>C. E. Jacome, J. M. Florez, G. Gordillo and Y. G. Gurevich</i>	236
Preparation and Study of Optoelectrical and Crystallographical Properties of ZnO Thin Films Deposited by Reactive Evaporation <i>C. Calderón and G. Gordillo</i>	239

Structural and Morphological Characterization of CdS _x Te _{1-x} Thin Films Deposited by Evaporation	243
<i>A. Dussan, G. Cediel, L. M. Caicedo, C. Calderon and G. Gordillo</i>	
 LOW DIMENSIONAL SYSTEMS 	
The Role of Excitons in Optical Properties of II-VI Semiconductor Heterostructures	249
<i>A. S. Camacho</i>	
Electronic States in Non-Rectangular Semiconductor Quantum Wells: Tight Binding Calculations	259
<i>S. J. Vlaev and V. R. Velasco</i>	
Optical Characterization of Low Dimensional II-VI Compound Heterostructures	270
<i>H. Sitter, W. Heiss and K. Hingerl</i>	
Inversion of a Donor Impurity Levels in a Spherical GaAs/Ga _{0.3} Al _{0.7} As/Ga _{0.55} Al _{0.45} As Double-Step Quantum Dot	284
<i>I. D. Mikhailov, F. J. Betancur and C. García</i>	
Wannier Exciton Binding Energy in a GaAs/Ga _{0.85} Al _{0.15} As/Ga _{0.7} Al _{0.3} As Double-Step Quantum Well	287
<i>I. D. Mikhailov, F. García and F. J. Betancur</i>	
Density of Shallow-Donor Impurity State in Gallium Arsenide Quantum Boxes	290
<i>A. Montes, C. A. Duque and N. Porras-Montenegro</i>	
Porous Silicon. Some Aspects of Photoluminescence Excitation	293
<i>T. V. Torchynska, J. P. Gómez, G. P. Polupan, A. G. Bórquez, G. Becerril-Espinoza, N. E. Korsunskaya and L. Yu. Khomenkova</i>	
Hot Electrons Power Losses in Quantum Wires	296
<i>F. Leon-Avila, H. Leon and F. Comas</i>	

Multichannel Transmission of Holes Through a Semiconductor Heterostructure	299
<i>L. Diago-Cisneros, R. Pérez-Alvarez, P. Pereyra-Padilla and H. Rodriguez-Coppola</i>	
Hot-Electron Transport in Quantum Wires: Optical Phonon Limited Mobility	302
<i>H. Leon, F. Leon-Avila and F. Comas</i>	
Optical Phonon Tunneling in Si/Ge Finite Superlattices: Normal Incidence	305
<i>F. De León-Pérez and R. Pérez-Alvarez</i>	
Optical Modes in Thin AlAs-Based Quantum Wells	308
<i>J. Nieto-Jalil and R. Pérez-Alvarez</i>	
Potential Models For Non Spherical Quantum Dots	311
<i>J. C. Drake-Pérez and J. Tutor-Sánchez</i>	
Confinement Effects in Spheroidal Quantum Dots	314
<i>J. C. Drake-Pérez and J. Tutor-Sánchez</i>	
Physical Properties of Metal Compounds Confined in Nanoporous Glass Matrices	317
<i>P. A. M. Aguilar, S. Mansurova, I. V. Plechakov, A. F. Madrigal, V. V. Matveev, G. P. Roskova and T. S. Tsekhomskaya</i>	
One Phonon Assisted Electron Raman Scattering in Semiconductor Quantum Well Wires, Free Standing Wires and Quantum Dots	323
<i>J. M. Bergues, R. Betancourt-Riera, R. Riera and J. L. Marín</i>	
Optical Absorption of Copper Implanted Silica: Theory and Experiment	326
<i>A. Bautista-Hernández, L. Meza-Montes, U. Pal and L. Rodríguez-Fernández</i>	
Electronic Spectrum of Fibonacci Mass Heterostructure	329
<i>O. Fernández, F. De León Pérez and R. Pérez-Alvarez</i>	
On the Nature of Exciton Emission in $Zn_{1-x}Cd_xSe$ Quantum Wells	332
<i>P. Díaz-Arencibia, I. Hernández-Calderón, L. M. Hernández-Ramirez and M. C. Tamargo</i>	

SUPERCONDUCTIVITY, MAGNETISM AND FERROELECTRICITY IN THIN FILMS

Surface Analysis of PZT Films Prepared by Sol-Gel Processing <i>B. E. Watts, F. Leccabue, G. Padeletti, G. Mattogno, S. Kaciulis and C. Veroli</i>	339
Growth, Structural and Magnetic Characterization of Ce and Rfe ₂ Epitaxial Ultra-Thin Films Prepared by Pulsed Laser Deposition <i>C. Meyer, S. Jaren and J. Rothman</i>	349
Magnetic Relaxation and Critical Currents in High-Tc Superconducting Thin Films with a Special Morphology <i>G. G. Rodriguez, I. V. Plechakov and Yu. I. Kuzmin</i>	359
Self Field Hysteresis of Polycrystalline Superconducting Tapes <i>A. Sáenz, H. Niculescu and P. J. Gielisse</i>	365
PMNT Ferroelectric Thin Films Deposited by Laser Ablation on Tin Electrodes <i>A. Fundora, H. Amorín, F. Calderón, E. Martínez, O. Contreras and J. M. Siqueiros</i>	368
Dissipation Mechanism of Ag-Doped YBCO Thin Films Grown by PLD <i>A. D. Hernández, C. Hart, M. Acosta, O. Arés and O. Ceh</i>	371
Compositional Fluctuation Effects on the Magnetotransport Measurements of La-Ca-Mn-O Thick Films with Colossal Magnetoresistance (CMR) <i>C. Hart, A. D. Hernández, O. Arés, W. Cauch and R. Escudero</i>	374
Silver Distribution in Superconducting YBCO Thin Films Made by Pld <i>C. Hart, A. D. Hernández, O. Arés, P. Bartolo and J. L. Peña</i>	377
Influence of the Target Age in the Ion Bombardment During off- Axis Deposition of YBa ₂ Cu ₃ O _x Films <i>O. Ares, M. Acosta, V. Sosa and C. Acosta</i>	380