

ISSN 1726-5749

SENSORS & TRANSDUCERS

10

vol. 12
Special
/11



Nanomaterials and their Composites: from Fabrication to Applications

International Frequency Sensor Association Publishing





Editors-in-Chief: professor Sergey Y. Yurish, tel.: +34 696067716, e-mail: editor@sensorsportal.com

Guest Editors: Ilze Aulika, Katarzyna Bejtko and Irena Drevenšek-Olenik

Editors for Western Europe

Meijer, Gerard C.M., Delft University of Technology, The Netherlands
Ferrari, Vittorio, Università di Brescia, Italy

Editor for Eastern Europe

Sachenko, Anatoly, Ternopil State Economic University, Ukraine

Editors for North America

Datskos, Panos G., Oak Ridge National Laboratory, USA
Fabien, J. Josse, Marquette University, USA
Katz, Evgeny, Clarkson University, USA

Editor South America

Costa-Felix, Rodrigo, Inmetro, Brazil

Editor for Africa

Maki K.Habib, American University in Cairo, Egypt

Editor for Asia

Ohyama, Shinji, Tokyo Institute of Technology, Japan

Editor for Asia-Pacific

Mukhopadhyay, Subhas, Massey University, New Zealand

Editorial Advisory Board

- Abdul Rahim, Ruzairi**, Universiti Teknologi, Malaysia
Ahmad, Mohd Noor, Northern University of Engineering, Malaysia
Annamalai, Karthigeyan, National Institute of Advanced Industrial Science and Technology, Japan
Arcega, Francisco, University of Zaragoza, Spain
Arguel, Philippe, CNRS, France
Ahn, Jae-Pyoung, Korea Institute of Science and Technology, Korea
Arndt, Michael, Robert Bosch GmbH, Germany
Ascoli, Giorgio, George Mason University, USA
Atalay, Selcuk, Inonu University, Turkey
Atghiaee, Ahmad, University of Tehran, Iran
Augutis, Vyngantas, Kaunas University of Technology, Lithuania
Avachit, Patil Lalchand, North Maharashtra University, India
Ayesh, Aladdin, De Montfort University, UK
Azamimi, Azian binti Abdullah, Universiti Malaysia Perlis, Malaysia
Bahreyini, Behraad, University of Manitoba, Canada
Baliga, Shankar, B., General Monitors Transnational, USA
Baoxian, Ye, Zhengzhou University, China
Barford, Lee, Agilent Laboratories, USA
Barlingay, Ravindra, RF Arrays Systems, India
Basu, Sukumar, Jadavpur University, India
Beck, Stephen, University of Sheffield, UK
Ben Bouzid, Sihem, Institut National de Recherche Scientifique, Tunisia
Benachaiba, Chellali, Universitaire de Bechar, Algeria
Binnie, T. David, Napier University, UK
Bischoff, Gerlinde, Inst. Analytical Chemistry, Germany
Bodas, Dhananjay, IMTEK, Germany
Borges Carval, Nuno, Universidade de Aveiro, Portugal
Bousbia-Salah, Mounir, University of Annaba, Algeria
Bouvet, Marcel, CNRS – UPMC, France
Brudzewski, Kazimierz, Warsaw University of Technology, Poland
Cai, Chenxin, Nanjing Normal University, China
Cai, Qingyun, Hunan University, China
Campanella, Luigi, University La Sapienza, Italy
Carvalho, Vitor, Minho University, Portugal
Cecelja, Franjo, Brunel University, London, UK
Cerda Belmonte, Judith, Imperial College London, UK
Chakrabarty, Chandan Kumar, Universiti Tenaga Nasional, Malaysia
Chakravorty, Dipankar, Association for the Cultivation of Science, India
Changhai, Ru, Harbin Engineering University, China
Chaudhari, Gajanan, Shri Shivaji Science College, India
Chavali, Murthy, N.I. Center for Higher Education, (N.I. University), India
Chen, Jiming, Zhejiang University, China
Chen, Rongshun, National Tsing Hua University, Taiwan
Cheng, Kuo-Sheng, National Cheng Kung University, Taiwan
Chiang, Jeffrey (Cheng-Ta), Industrial Technol. Research Institute, Taiwan
Chiriac, Horia, National Institute of Research and Development, Romania
Chowdhuri, Arijit, University of Delhi, India
Chung, Wen-Yaw, Chung Yuan Christian University, Taiwan
Corres, Jesus, Universidad Publica de Navarra, Spain
Cortes, Camilo A., Universidad Nacional de Colombia, Colombia
Courtois, Christian, Universite de Valenciennes, France
Cusano, Andrea, University of Sannio, Italy
D'Amico, Arnaldo, Università di Tor Vergata, Italy
De Stefano, Luca, Institute for Microelectronics and Microsystem, Italy
Deshmukh, Kiran, Shri Shivaji Mahavidyalaya, Barshi, India
Dickert, Franz L., Vienna University, Austria
Dieguez, Angel, University of Barcelona, Spain
Dighavkar, C. G., M.G. Vidyamandir's L. V.H. College, India
Dimitropoulos, Panos, University of Thessaly, Greece
Ding, Jianning, Jiangsu Polytechnic University, China
Djordjevic, Alexandar, City University of Hong Kong, Hong Kong
Donato, Nicola, University of Messina, Italy
Donato, Patricio, Universidad de Mar del Plata, Argentina
Dong, Feng, Tianjin University, China
Drljaca, Predrag, Instersema Sensoric SA, Switzerland
Dubey, Venketesh, Bournemouth University, UK
Enderle, Stefan, Univ.of Ulm and KTB Mechatronics GmbH, Germany
Erdem, Gursan K. Arzum, Ege University, Turkey
Erkmen, Aydan M., Middle East Technical University, Turkey
Estelle, Patrice, Insa Rennes, France
Estrada, Horacio, University of North Carolina, USA
Faiz, Adil, INSA Lyon, France
Fericean, Sorin, Balluff GmbH, Germany
Fernandes, Joana M., University of Porto, Portugal
Francioso, Luca, CNR-IMM Institute for Microelectronics and Microsystems, Italy
Francis, Laurent, University Catholique de Louvain, Belgium
Fu, Weiling, South-Western Hospital, Chongqing, China
Gaura, Elena, Coventry University, UK
Geng, Yanfeng, China University of Petroleum, China
Gole, James, Georgia Institute of Technology, USA
Gong, Hao, National University of Singapore, Singapore
Gonzalez de la Rosa, Juan Jose, University of Cadiz, Spain
Grael, Annette, Goteborg University, Sweden
Graff, Mason, The University of Texas at Arlington, USA
Guan, Shan, Eastman Kodak, USA
Guillet, Bruno, University of Caen, France
Guo, Zhen, New Jersey Institute of Technology, USA
Gupta, Narendra Kumar, Napier University, UK
Hadjiloucas, Sillas, The University of Reading, UK
Haider, Mohammad R., Sonoma State University, USA
Hashsham, Syed, Michigan State University, USA
Hasni, Abdelhafid, Bechar University, Algeria
Hernandez, Alvaro, University of Alcalá, Spain
Hernandez, Wilmar, Universidad Politecnica de Madrid, Spain
Homentcovschi, Dorel, SUNY Binghamton, USA
Horstman, Tom, U.S. Automation Group, LLC, USA
Hsiai, Tzung (John), University of Southern California, USA
Huang, Jeng-Sheng, Chung Yuan Christian University, Taiwan
Huang, Star, National Tsing Hua University, Taiwan
Huang, Wei, PSG Design Center, USA
Hui, David, University of New Orleans, USA
Jaffrezic-Renault, Nicole, Ecole Centrale de Lyon, France
Jaime Calvo-Galleg, Jaime, Universidad de Salamanca, Spain
James, Daniel, Griffith University, Australia
Janting, Jakob, DELTA Danish Electronics, Denmark
Jiang, Liudi, University of Southampton, UK
Jiang, Wei, University of Virginia, USA
Jiao, Zheng, Shanghai University, China
John, Joachim, IMEC, Belgium
Kalach, Andrew, Voronezh Institute of Ministry of Interior, Russia
Kang, Moonho, Sunmoon University, Korea South
Kaniasas, Eugenijus, Vienna University of Technology, Austria
Katake, Anup, Texas A&M University, USA
Kausel, Wilfried, University of Music, Vienna, Austria
Kavasoglu, Nese, Mugla University, Turkey
Ke, Cathy, Tyndall National Institute, Ireland
Khelfaoui, Rachid, Université de Bechar, Algeria
Khan, Asif, Aligarh Muslim University, Aligarh, India
Kim, Min Young, Kyungpook National University, Korea South

Ko, Sang Choon, Electronics. and Telecom. Research Inst., Korea South
Kotulska, Malgorzata, Wroclaw University of Technology, Poland
Kockar, Hakan, Balikesir University, Turkey
Kong, Ing, RMIT University, Australia
Kratz, Henrik, Uppsala University, Sweden
Krishnamoorthy, Ganesh, University of Texas at Austin, USA
Kumar, Arun, University of South Florida, USA
Kumar, Subodh, National Physical Laboratory, India
Kung, Chih-Hsien, Chang-Jung Christian University, Taiwan
Lacnjevac, Caslav, University of Belgrade, Serbia
Lay-Ekuakille, Aime, University of Lecce, Italy
Lee, Jang Myung, Pusan National University, Korea South
Lee, Jun Su, Amkor Technology, Inc. South Korea
Lei, Hua, National Starch and Chemical Company, USA
Li, Fengyuan (Thomas), Purdue University, USA
Li, Genxi, Nanjing University, China
Li, Hui, Shanghai Jiaotong University, China
Li, Xian-Fang, Central South University, China
Li, Yuefa, Wayne State University, USA
Liang, Yuanchang, University of Washington, USA
Liawruangrath, Saisunee, Chiang Mai University, Thailand
Liew, Kim Meow, City University of Hong Kong, Hong Kong
Lin, Hermann, National Kaohsiung University, Taiwan
Lin, Paul, Cleveland State University, USA
Linderholm, Pontus, EPFL - Microsystems Laboratory, Switzerland
Liu, Aihua, University of Oklahoma, USA
Liu Changgeng, Louisiana State University, USA
Liu, Cheng-Hsien, National Tsing Hua University, Taiwan
Liu, Songqin, Southeast University, China
Lodeiro, Carlos, University of Vigo, Spain
Lorenzo, Maria Encarnacio, Universidad Autonoma de Madrid, Spain
Lukaszewicz, Jerzy Pawel, Nicholas Copernicus University, Poland
Ma, Zhanfang, Northeast Normal University, China
Majstorovic, Vidosav, University of Belgrade, Serbia
Malyshev, V.V., National Research Centre 'Kurchatov Institute', Russia
Marquez, Alfredo, Centro de Investigacion en Materiales Avanzados, Mexico
Matay, Ladislav, Slovak Academy of Sciences, Slovakia
Mathur, Prafull, National Physical Laboratory, India
Maurya, D.K., Institute of Materials Research and Engineering, Singapore
Mekid, Samir, University of Manchester, UK
Melnyk, Ivan, Photon Control Inc., Canada
Mendes, Paulo, University of Minho, Portugal
Mennell, Julie, Northumbria University, UK
Mi, Bin, Boston Scientific Corporation, USA
Minas, Graca, University of Minho, Portugal
Moghavvemi, Mahmoud, University of Malaya, Malaysia
Mohammadi, Mohammad-Reza, University of Cambridge, UK
Molina Flores, Esteban, Benemérita Universidad Autónoma de Puebla, Mexico
Moradi, Majid, University of Kerman, Iran
Morello, Rosario, University "Mediterranea" of Reggio Calabria, Italy
Mounir, Ben Ali, University of Sousse, Tunisia
Mrad, Nezih, Defence R&D, Canada
Mulla, Imtiaz Sirajuddin, National Chemical Laboratory, Pune, India
Nabok, Aleksey, Sheffield Hallam University, UK
Neelamegam, Periasamy, Sastra Deemed University, India
Neshkova, Milka, Bulgarian Academy of Sciences, Bulgaria
Oberhammer, Joachim, Royal Institute of Technology, Sweden
Ould Lahoucine, Cherif, University of Guelma, Algeria
Pamidighanta, Sayanu, Bharat Electronics Limited (BEL), India
Pan, Jisheng, Institute of Materials Research & Engineering, Singapore
Park, Joon-Shik, Korea Electronics Technology Institute, Korea South
Penza, Michele, ENEA C.R., Italy
Pereira, Jose Miguel, Instituto Politecnico de Seteбал, Portugal
Petsev, Dimiter, University of New Mexico, USA
Pogacnik, Lea, University of Ljubljana, Slovenia
Post, Michael, National Research Council, Canada
Prance, Robert, University of Sussex, UK
Prasad, Ambika, Gulbarga University, India
Prateepsasen, Asa, Kingmoungut's University of Technology, Thailand
Pullini, Daniele, Centro Ricerche FIAT, Italy
Pumera, Martin, National Institute for Materials Science, Japan
Radhakrishnan, S., National Chemical Laboratory, Pune, India
Rajanna, K., Indian Institute of Science, India
Ramadan, Qasem, Institute of Microelectronics, Singapore
Rao, Basuthkar, Tata Inst. of Fundamental Research, India
Raouf, Kosai, Joseph Fourier University of Grenoble, France
Rastogi Shiva, K., University of Idaho, USA
Reig, Candid, University of Valencia, Spain
Restivo, Maria Teresa, University of Porto, Portugal
Robert, Michel, University Henri Poincare, France
Rezazadeh, Ghader, Urmia University, Iran
Royo, Santiago, Universitat Politècnica de Catalunya, Spain
Rodriguez, Angel, Universitat Politècnica de Catalunya, Spain
Rothberg, Steve, Loughborough University, UK
Sadana, Ajit, University of Mississippi, USA
Sadeghian Marnani, Hamed, TU Delft, The Netherlands
Sandacci, Serghei, Sensor Technology Ltd., UK
Sapozhnikova, Ksenia, D.I.Mendeleyev Institute for Metrology, Russia
Saxena, Vibha, Bhabha Atomic Research Centre, Mumbai, India
Schneider, John K., Ultra-Scan Corporation, USA
Sengupta, Deepak, Advance Bio-Photonics, India
Seif, Selemani, Alabama A & M University, USA
Seifter, Achim, Los Alamos National Laboratory, USA
Shah, Kriyang, La Trobe University, Australia
Silva Girao, Pedro, Technical University of Lisbon, Portugal
Singh, V. R., National Physical Laboratory, India
Slomovitz, Daniel, UTE, Uruguay
Smith, Martin, Open University, UK
Soleymanpour, Ahmad, Damghan Basic Science University, Iran
Somani, Prakash R., Centre for Materials for Electronics Technol., India
Srinivas, Talabattula, Indian Institute of Science, Bangalore, India
Srivastava, Arvind K., NanoSonix Inc., USA
Stefan-van Staden, Raluca-Ioana, University of Pretoria, South Africa
Stefanescu, Dan Mihai, Romanian Measurement Society, Romania
Sumriddetchka, Sarun, National Electronics and Computer Technology Center, Thailand
Sun, Chengliang, Polytechnic University, Hong-Kong
Sun, Dongming, Jilin University, China
Sun, Junhua, Beijing University of Aeronautics and Astronautics, China
Sun, Zhiqiang, Central South University, China
Suri, C. Raman, Institute of Microbial Technology, India
Sysoev, Victor, Saratov State Technical University, Russia
Szewczyk, Roman, Industrial Research Inst. for Automation and Measurement, Poland
Tan, Ooi Kiang, Nanyang Technological University, Singapore
Tang, Dianping, Southwest University, China
Tang, Jaw-Luen, National Chung Cheng University, Taiwan
Teker, Kasif, Frostburg State University, USA
Thirunavukkarasu, I., Manipal University Karnataka, India
Thumbavanam Pad, Kartik, Carnegie Mellon University, USA
Tian, Gui Yun, University of Newcastle, UK
Tsiantos, Vassilios, Technological Educational Institute of Kaval, Greece
Tsigara, Anna, National Hellenic Research Foundation, Greece
Twomey, Karen, University College Cork, Ireland
Valente, Antonio, University, Vila Real, - U.T.A.D., Portugal
Wang, Raghav Rao, Summit Technology Services, Inc., USA
Vaseashta, Ashok, Marshall University, USA
Vazquez, Carmen, Carlos III University in Madrid, Spain
Vieira, Manuela, Instituto Superior de Engenharia de Lisboa, Portugal
Vigna, Benedetto, STMicroelectronics, Italy
Yrba, Radimir, Brno University of Technology, Czech Republic
Wandelt, Barbara, Technical University of Lodz, Poland
Wang, Jiangping, Xi'an Shiyou University, China
Wang, Kedong, Beihang University, China
Wang, Liang, Pacific Northwest National Laboratory, USA
Wang, Mi, University of Leeds, UK
Wang, Shinn-Fwu, Ching Yun University, Taiwan
Wang, Wei-Chih, University of Washington, USA
Wang, Wensheng, University of Pennsylvania, USA
Watson, Steven, Center for NanoSpace Technologies Inc., USA
Weiping, Yan, Dalian University of Technology, China
Wells, Stephen, Southern Company Services, USA
Wolkenberg, Andrzej, Institute of Electron Technology, Poland
Woods, R. Clive, Louisiana State University, USA
Wu, DerHo, National Pingtung Univ. of Science and Technology, Taiwan
Wu, Zhaoyang, Hunan University, China
Xiu Tao, Ge, Chuzhou University, China
Xu, Lisheng, The Chinese University of Hong Kong, Hong Kong
Xu, Sen, Drexel University, USA
Xu, Tao, University of California, Irvine, USA
Yang, Dongfang, National Research Council, Canada
Yang, Shuang-Hua, Loughborough University, UK
Yang, Wuqiang, The University of Manchester, UK
Yang, Xiaoling, University of Georgia, Athens, GA, USA
Yaping Dan, Harvard University, USA
Ymeti, Aurel, University of Twente, Netherland
Yong Zhao, Northeastern University, China
Yu, Haihu, Wuhan University of Technology, China
Yuan, Yong, Massey University, New Zealand
Yufera Garcia, Alberto, Seville University, Spain
Zakaria, Zulkarnay, University Malaysia Perlis, Malaysia
Zagnoni, Michele, University of Southampton, UK
Zamani, Cyrus, Universitat de Barcelona, Spain
Zeni, Luigi, Second University of Naples, Italy
Zhang, Minglong, Shanghai University, China
Zhang, Qintao, University of California at Berkeley, USA
Zhang, Weiping, Shanghai Jiao Tong University, China
Zhang, Wenming, Shanghai Jiao Tong University, China
Zhang, Xueji, World Precision Instruments, Inc., USA
Zhong, Haoxiang, Henan Normal University, China
Zhu, Qing, Fujifilm Dimatix, Inc., USA
Zorzano, Luis, Universidad de La Rioja, Spain
Zourob, Mohammed, University of Cambridge, UK

Contents

Volume 12
Special Issue
October 2011

www.sensorsportal.com

ISSN 1726-5479

Research Articles

Preface

Ilze Aulika, Katarzyna Bejtka, Irena Drevenšek-Olenik..... 1

Large-scale Synthesis of WS₂ Multiwall Nanotubes and their Dispersion, an Update

Alla Zak, Liat Sallacan Ecker, Roni Efrati, Larissa Drangai, Niles Fleischer and Reshef Tenne..... 1

Distributed Array of Polymeric Piezo-nanowires through Hard-Templating Method into Porous Alumina

Valentina Cauda, Davide Dapra, Ilze Aulika, Angelica Chiodoni, Danilo Demarchi, Pierluigi Civera, Marco Pizzi..... 11

Effect of Mo₆S_xI_{10-x} Nanotubes Addition on Electrooptical Properties of Polymer-dispersed Liquid Crystals

Jerneja Milavec, Aleš Mrzel, Irena Drevenšek-Olenik, Mykhailo Pevnyi, Victor Reshetnyak..... 18

Charge Transfer Properties of Surface-treated WS₂ Nanotubes and Fullerene-like Nanoparticles

Tiziana Di Luccio, Carmela Borriello, Sumeet Kumar, Giuseppe Nenna..... 26

Nanomaterials Characterization Using Nuclear Methods at IFIN-HH

Ion Burducea, Liviu Stefan Craciun, Cristina Ionescu, Mihai Straticiu, Alin Titus Serban, Petru Mihai Racolta..... 33

Transient Grating Experiments on Inorganic–elastomer Nanocomposites

Andrea Taschin, Paolo Bartolini, Antoni Sánchez-Ferrer, Raffaele Mezzenga, Aleš Mrzel and Renato Torre..... 46

The Mechanical and Tribological Properties of Epoxy Nanocomposites with WS₂ Nanotubes

Elad Zohar, Sharon Baruch, Mark Shneider, Hanna Dodiuk, Samuel Kenig, H. Daniel Wagner, Alla Zak, Alex Moshkovith, Lev Rapoport, Reshef Tenne..... 53

Ultrasonic Characterization of Dynamic Elastic Properties of Polymer Composites with Inorganic Nanotubes

V. Samulionis, J. Banys, A. Sanches-Ferrer and R. Mezzenga..... 66

Dynamic- and Thermo- mechanical Analysis of Inorganic Nanotubes/elastomer Composites

Armin Fuith, Marius Reinecker, Antoni Sánchez-Ferrer, Raffaele Mezzenga, Aleš Mrzel, Maris Knite, Ilze Aulika, Marija Duncic and Wilfried Schranz..... 71

Authors are encouraged to submit article in MS Word (doc) and Acrobat (pdf) formats by e-mail: editor@sensorsportal.com
Please visit journal's webpage with preparation instructions: <http://www.sensorsportal.com/HTML/DIGEST/Submission.htm>

The 3rd COINAPO Topical Meeting

Composites of Inorganic Nanotubes & Polymers

“Nanomaterials & their composites: from fabrication to applications”

March 2 - 3, 2011

Sestriere, Italy



COINAPO

Is an activity in the framework of
*European Cooperation in the field
of Scientific & Technical Research (COST).*



Inorganic nanotubes are an interesting alternative to carbon nanotubes, showing advantages such as easy synthetic access, good uniformity & solubility, & predefined electrical conductivity depending on the composition of the starting material. They are therefore very promising candidates as fillers for polymer composites with enhanced thermal, mechanical, & electrical properties.

TOPICS

- Synthesis of nanotube materials
- Functionalization of the nanotubes
- Dispersion & alignment of nanotubes in polymer networks
- Characterization of composite materials
- Theory on the fundamentals of composites
- Applications:
 - Self-powered devices
 - Automotive & aeronautics
 - Optical communication networks
 - Organic solar cells
 - Composites for heat dissipation, electromagnetic interference shielding & electrostatic dissipation
 - Composites for wear protection
 - Large area flexible multifunctional sensors
 - Smart sensors

LOCATION

Ròseo Hotels Sestriere****
Via Sauze 3/B ,10058, Sestriere, Italy

CONFERENCE FEE

COINAPO Conference has no fee: it is free of charge.

PAPERS

Will be published in the  *Sensors & Transducers Journal* e-journal of *International Frequency Sensor Association*.



INVITED SPEAKERS

Jinhui Song

Center for Nanostructure, Georgia Institute of Technology, Atlanta (USA)

Gianfranco Innocenti

New Materials Scouting and Nanomaterials , Centro Ricerche FIAT, Orbassano (Italy)

Wolfgang Tremel

Institute of Inorganic Chemistry and Analytical Chemistry, Johannes Gutenberg Universität Mainz, Mainz (Germany)

Adreano Zecchina

Center of Excellence “Nanostructured Interfaces and Surfaces, University of Turin, Turin (Italy)

Thibault Vilette

e-Xstream engineering SaRL, Bascharage (Luxembourg)

Marco Pizzi

Eltel Group, Casale (Italy)

Giulio Lamedica

Zeiss NTS, Oberkochen (Germany)

ORGANAZ

Center for Space Human Robotics
Italian Institute of Technology IIT@POLITO



ORGANIZING COMMITTEE

Ilze Aulika
Valentina Cauda
Marco Crepaldi
Katarzyna Bejtka
Alice Dimonte

SCIENTIFIC COMMITTEE

Māris Knite
Wilfried Schranz
Ilze Aulika
Irena Drevenšek Olenik

LINKS

www.coinapo.eu
www.roseohotelsestriere.com
www.iit.it
<http://shr.iit.it>



Selected papers of the 3rd Topical Meeting on Composites of Inorganic Nanotubes & Polymers (COINAPO) "Nanomaterials & their Composites: from Fabrication to Applications", 2-3 March 2011, Sestriere, Italy

Preface

Ilze Aulika, Katarzyna Bejtka, Irena Drevenšek-Olenik

Received: 15 June 2011 /Accepted: 18 July 2011 /Published: 31 October 2011

This issue contains a selection of papers presented at the 3rd Topical Meeting on Composites of Inorganic Nanotubes and Polymers (COINAPO), which was held at the Roseo Hotel in Sestriere (Italy) from March 3 to March 4, 2011. The meeting was organized by the Center for Space Human Robotics (IIT@PoliTO) at Italian Institute of Technology (IIT) in Turin (Italy) and was following immediately after the PIEZO 2011 conference, organized by the Centro Ricerca FIAT. This enabled easy participation of researchers to both events that had several overlapping topics. Both meetings shared one invited speaker - Dr. Jinhui Song from Georgia Institute of Technology (USA).

The 3rd COINAPO Topical Meeting was attended by 40 researchers, including 7 invited speakers (3 from universities and 4 from industry). It brought together researchers from 17 European countries, Israel and USA. The presentations were divided into 6 oral sessions that included 7 invited talks presented by distinguished experts in their fields and 22 contributed talks. The technical sessions encompassed many developing and challenging topics, which included synthesis and functionalization of inorganic (piezoelectrics and chalcogenides) nanotube materials, dispersion and alignment of nanotubes in polymer networks, new alternative characterization methods of composite materials and applications. The large number of invited speakers gave significant insight to the topics of the conference, especially related to fabrication, characterization and applications of composites. Several invited speakers were representing industry, including automotive (FIAT), automotive and household (ELTEK), and producers of high resolution scanning electron microscopy (Carl ZEISS) and transmission electron microscopy (FEI). The conference was accompanied by a commercial exhibition of AFM instrumentation of the NT-MDT company – a leading manufacturer offering variety of nanotechnology instrumentation for different fields of research.

COINAPO is also an abbreviation for the European Cooperation in Science and Technology (COST) Action MP0902 entitled “Composites of Inorganic Nanotubes and Polymers”. COST is the longest running and widest European intergovernmental network for cooperation in research established by a Ministerial Conference of 19 European States in 1971. The goal of the COINAPO is to coordinate interdisciplinary research efforts across Europe needed to gain knowledge on fundamental features of inorganic nanotube-polymer composites and create widespread links needed for application and commercialization of this kind of composite media by European industry. Nanotubes made of

inorganic materials are an interesting alternative to carbon nanotubes, showing advantages such as e.g. easy synthetic access, good uniformity and solubility, and predefined electrical conductivity depending on the composition of the starting material. They are therefore very promising candidates as fillers for polymer composites with enhanced thermal, mechanical, and electrical properties. Target applications for this kind of composites are materials for heat management, electrostatic dissipaters, wear protection materials, photovoltaic elements, etc. Collaborative efforts are needed on this rapidly emerging field to create a basis for a highly interdisciplinary research network focused on development and exploration of inorganic nanotube-polymer composites. COINAPO started with its activities in November 2009 and at the moment links together scientists from 24 COST countries and Ukraine as the near neighbour country. About 50 research groups are contributing to the “COINAPO activities”.

This issue presents the first results of collaborative research performed within the COINAPO, merging together the knowledge of scientific groups on (i) synthesis and characterization of nanotube materials with the groups that have experience in (ii) fabrication of polymer composites with carbon nanotubes (CNTs) and/or other additives and their characterization. The collected papers cover different fields starting from synthesis and characterization of composites, and concluding with the results more dedicated to applications. For example, Zak *et al.* reports the new process of large scale synthesis (50-100 g/batch) of a pure phase of multiwall WS₂ nanotubes. In view of their excellent mechanical properties and semiconducting characteristics, large number of applications could be anticipated for such nanotubes, especially in reinforcing variety of nanocomposites and for use in sensors, actuators, etc.

The paper of Cauda *et al.* represents preparation and characterization of ferroelectric polymeric nanowires (poly(vinylidene fluoride) - PVDF) through hard-templating strategy. The Curie temperature tests show an increase towards the higher temperatures for the PVDF nanowires with respect to the bulk PVDF material, thus revealing the importance of confined crystallization into mono-dimensional structures.

Milavec *et al.* demonstrated that switching voltage of the polymer - liquid crystal composites with addition of 0.1 wt% Mo₆S₄I₆ nanotubes is considerably lowered with respect to the switching voltage of the analogous structures without the nanotubes. The addition of nanotubes causes a decrease of the threshold voltage and also improves the switching speed upon modification of an external voltage.

Di Luccio *et al.* studied the effect of incorporation of inorganic fullerene like nanoparticles and WS₂ nanotubes into device structures for organic electronics applications. Poly-3(hexylthiophene) has been used along with the WS₂ nanoparticles as an active layer for the solution-processable material in the OLED structure of the type ITO/WS₂/P3HT/LiF-Al. The investigation was focused on the electrical effect of the WS₂ layer and on obtaining information on its energy levels.

The new approach of the studies of composites is presented by Burducea *et al.*, suggesting the use of nuclear methods for characterisation of nanomaterials: Positron Annihilation Spectroscopy (PAS), Nuclear Reaction Analysis (NRA) and Rutherford Backscattering Spectrometry (RBS). PAS investigation is demonstrated on polymer nanofibers providing information on vacancy defects, RBS was applied on InN thin films providing information regarding the thickness and the stoichiometry of the films. Preliminary NRA results show the possibility of detecting and measuring the hydrogen content in CNW.

Taschin *et al.* report on the use of transient-grating based time-resolved laser spectroscopy technique (TG) for investigations of thermo-elastic response of the composites. A new dynamic phenomenon producing unusual photo-elastic and photo-thermal response was found in polyurea elastomer mixed with inorganic nanotubes (MoS₂) or nanowires (Mo₆S₂I₈).

The study of Zohar *et al.* is dedicated to the investigation of the effect of WS₂ nanotubes on the mechanical, thermal, adhesion and tribological properties of epoxy based nanocomposites: it is shown that addition of nanotubes significantly improves all these properties, which makes inorganic nanotubes-polymer composites very promising application in different mechanical devices.

The temperature dependence of ultrasonic velocity and attenuation in an elastomeric material doped with MoS₂ nanotubes were also studied. These results are presented in the paper of Samulionis *et al.* The observed increase of the low temperature ultrasonic velocity in polymer with nanotubes is in good agreement with an increased value of the elastic modulus found by other research groups.

The dynamic mechanical analysis (DMA) and thermomechanical analysis (TMA) measurements are presented in the work of Fuith *et al.* Also this group had studied polyurea elastomer nanocomposites based on MoS₂ nanotubes and Mo₆S₂I₈ nanowires. The addition of a small amount of nanoparticles (<1 wt %) leads to the increase of the glass transition temperature and the Young's modulus of up to 15% in the whole measured temperature range.

The selection of the papers presented in this volume reflects the multidisciplinary and multinational nature of the COINAPO network.

We would like to thank to all colleagues and students of the Center for Space Human Robotics (IIT@PoliTO) for their support in organization of the conference. We are especially indebted to Alessandro Zanella from Centro Ricerca FIAT, Dr. Valentina Cauda and Dr. Gabriele Ballero from IIT, Prof. Pierluigi Civera and Prof. Danilo Demarchi from Politecnico di Torino, for their invaluable help in organizing the conference. Our acknowledgements also go to our sponsors – European Cooperation in Science and Technology (COST), International Frequency Sensor Association, and Associazione Tecnica dell'Automobile and Italian Institute of Technology for their financial support that has made the 3rd Topical Meeting of COINAPO possible. Finally, we express our gratitude to the invited speakers and to all coauthors of their contributions for the success of the conference. We are also grateful to the staff of International Frequency Sensor Association, for their careful attention to the preparation of this issue, and to referees of this proceeding, for their assistance. The series of COINAPO meetings will continue to be held in the future, reflecting the progress in the field of inorganic nanotubes – polymer composites, while maintaining the traditions of past meetings.



All papers published in this volume of Sensors & Transducers Journal, Vol.12, Special Issue, have been peer reviewed through processes administered by the proceedings Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by International Frequency Sensor Association (IFSA) Publishing.

Sensors Industry News



**FREE Monthly
IFSA Newsletter**

ISSN 1726-6017

SUBSCRIBE NOW

subscribe@sensorsportal.com

Universal Sensors and Transducers Interface (USTI)

for any sensors and transducers with frequency, period, duty-cycle, time interval,
PWM, phase-shift, pulse number output



- * Input frequency range:
0.05 Hz ... 9 MHz (144 MHz)
- * Selectable and constant relative error:
1 ... 0.0005 % for all frequency range
- * Scalable resolution
- * Non-redundant conversion time
- * RS232, SPI, I2C interfaces
- * Rotational speed, *rpm*
- * Cx, 50 pF to 100 μ F
- * Rx, 10 Ω to 10 M Ω
- * Pt100, Pt1000, Pt5000, Cu, Ni
- * Resistive Bridges
- * PDIP, TQFP, MLF packages

Just make it easy !

<http://www.techassist2010.com/> info@techassist2010.com

Guide for Contributors

Aims and Scope

Sensors & Transducers Journal (ISSN 1726-5479) provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes state-of-the-art reviews, regular research and application specific papers, short notes, letters to Editor and sensors related books reviews as well as academic, practical and commercial information of interest to its readership. Because of it is a peer reviewed international journal, papers rapidly published in *Sensors & Transducers Journal* will receive a very high publicity. The journal is published monthly as twelve issues per year by International Frequency Sensor Association (IFSA). In addition, some special sponsored and conference issues published annually. *Sensors & Transducers Journal* is indexed and abstracted very quickly by Chemical Abstracts, IndexCopernicus Journals Master List, Open J-Gate, Google Scholar, etc. Since 2011 the journal is covered and indexed (including a Scopus, Embase, Engineering Village and Reaxys) in Elsevier products.

Topics Covered

Contributions are invited on all aspects of research, development and application of the science and technology of sensors, transducers and sensor instrumentations. Topics include, but are not restricted to:

- Physical, chemical and biosensors;
- Digital, frequency, period, duty-cycle, time interval, PWM, pulse number output sensors and transducers;
- Theory, principles, effects, design, standardization and modeling;
- Smart sensors and systems;
- Sensor instrumentation;
- Virtual instruments;
- Sensors interfaces, buses and networks;
- Signal processing;
- Frequency (period, duty-cycle)-to-digital converters, ADC;
- Technologies and materials;
- Nanosensors;
- Microsystems;
- Applications.

Submission of papers

Articles should be written in English. Authors are invited to submit by e-mail editor@sensorsportal.com 8-14 pages article (including abstract, illustrations (color or grayscale), photos and references) in both: MS Word (doc) and Acrobat (pdf) formats. Detailed preparation instructions, paper example and template of manuscript are available from the journal's webpage: <http://www.sensorsportal.com/HTML/DIGEST/Submission.htm> Authors must follow the instructions strictly when submitting their manuscripts.

Advertising Information

Advertising orders and enquires may be sent to sales@sensorsportal.com Please download also our media kit: http://www.sensorsportal.com/DOWNLOADS/Media_Kit_2011.pdf

The Handbook of Laboratory Measurements and Instrumentation presents experimental and laboratory activities with an approach as close as possible to reality, even offering remote access to experiments, providing to the reader an excellent tool for learning laboratory techniques and methodologies. Book includes dozens videos, animations and simulations following each of chapters. It makes the title very valued and different from existing books on measurements and instrumentation.



This unique methodological book comprises 13 chapters. Each one presents a clearly defined learning objective, the essential concepts and a step-by-step guide for performing the experimental activity, various complementary multimedia contents and a final synthesis. The set of open questions that closes each module is intended to provide formative assessment.

The Handbook of Laboratory Measurements and Instrumentation significantly contributes to the dissemination of experimental activity in engineering education and to facilitate the conception, tuning and exploration of experimental systems for laboratory training. The full technical description of the equipment is provided to make the setups easily reproducible. Engineers, technicians and students who are working in measuring laboratories will find plenty of practical information here for solving daily problems.

Order online:

http://www.sensorsportal.com/HTML/BOOKSTORE/Handbook_of_Measurements.htm



www.sensorsportal.com