University of Connecticut
Institute of Materials Science

IMS Associates Program Newsletter

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Mid-Length Projects (MLP) Program

The Institute of Materials Science (IMS) announces the creation of a new program that addresses seed research/development projects of an intermediate length. This program is designed to encourage university/ industry collaboration on projects that are too extensive for the existing Associates Program yet smaller than full-blown university research projects. Typical student/post-doc supporting research projects at IMS (and most of UConn and other institutions) last for some number of years. Industry often has exploratory projects of intermediate length between these extremes, projects that may require several months to a year of full time effort. Through the Mid-Length Projects (MLP) Program IMS will assist industry in matching the available resources of IMS to those required for the project of interest.

For more information or to discuss specific projects please contact Ed Kurz (860-486-4186, ekurz@mail.ims.uconn. edu) or Harris Marcus (860-486-4623, hmarcus@mail.ims.uconn.edu).

Myer Ezrin, IMS Associates Program Director, Retires, Ed Kurz Succeeds Him as Director

Dr. Myer Ezrin, Director of the IMS Associates Program for 26 years, retired on June 30, 2006. At UConn he directed the IMS Associates Program, an industrial outreach program, and did research on plastics analysis, plastics failure analysis and electrical insulation. He received a B.S. in chemistry at Tufts and a Ph.D. in organic chemistry at Yale. His doctoral research was on electron exchange polymers. Prior to joining the Institute of Materials Science (IMS) at the University of Connecticut in 1980, he had worked in industry at Dupont, Monsanto and Springborn Laboratories, a plastics consulting company. He is a past chairman of the Society of Plastics Engineers (SPE) Failure Analysis and Prevention Special Interest Group and has been President of the Western New England Section. Dr. Ezrin is coauthor of a 1983 book on plastics analysis and has published papers and presented lectures extensively in his

Inside this issue:

Nanotechnology in Connecticut	*3*
UConn Biodiesel Consortium	*3*
Focus on Research	*4*
New Faculty	*6*
Members Corner: Techni-Met, Inc.	*7*
Patents Granted, Applications and Licenses	*8*
Department Seminars	*8*
Fall Semester Starts	*9*
IMS Short Course	*9*
Technology Incubation Program	*10*
Laticrete International Celebrates 50th Anniversary	*10*
Polymer Seminars	*11*
Sample Preparation	*12*

areas of expertise. At Springborn Laboratories he specialized in technical support and was an expert witness in patent infringement and product liability litigation. He has testified or advised in the United States, Canada, England and Australia. He is author of the 1996 book "Plastics Failure Guide - Cause and Prevention" sponsored by SPE. Dr. Ezrin was an advisor to the UConn Student Chapter of SPE and is a member of SPE Polymer Analysis Division, the Failure Analysis and Prevention Special Interest Group, and the New Technology Committee. In 1999 he was elected Fellow of the Society of Plastics Engineers. In 2002 he was given the Society of Plastics Engineers Annual Technical Conference, Polymer Analysis Division Best Paper Award.

Dr. Ezrin continues to be active in these fields and is planning a second edition to his Plastics Failure Guide, a presentation in September at the 2nd International Conference on Engineering Failure in Toronto and is preparing a short course on Failure of Materials with Art McEvily, Emeritus Faculty, Materials Science and Engineering.

We wish Dr. Ezrin good luck, good health and hope he enjoys all of his endeavors in his retirement.

Dr. Edward Kurz, previously Associate Director of the IMS Associates Program, has been promoted to Director of the Program. Edward Kurz received a B.S. in physics, M.S. in electrical engineering and Ph.D. in Materials Science at Rensselaer Polytechnic Institute. His doctoral research was in catalysis in Fe systems. Dr. Kurz also spent a year as a postdoctoral researcher at the Center for Multiphase Research at Rensselaer Polytechnic Institute. Prior to joining the Institute of Materials Science (IMS) at the University of Connecticut (UConn) he worked in industry as an engineer at Galileo ElectroOptics and as Manager of Materials Research and Development at Schott Fiber Optics. At UConn Dr. Kurz has been the Associate Director of the IMS Associates Program since 1994 and a Research Scientist in IMS, where he does research in applied surface characterization. In the Associates Program he directs the analyses of materials related product failures, characterization of materials, identification of contaminants and selection of materials for improved performance. Dr. Kurz also defines and organizes short courses of interest to regional industry. He has presented short courses in surface characterization and is the author of numerous publications in the field of surface analysis and modification.

Dr. Fiona Leek joined IMS as Associate Director of the IMS Associates Program in April of this year. Dr. Leek received a M.S. in Textile Science and Engineering at North Carolina State University and a Ph.D. in Polymer Science at the Institute of Materials Science, University of Connecticut. Her master's research involved the study of directional variation in fabric properties and their effects on sewability. Her doctoral research involved monitoring property changes in nylons induced by blending with small concentrations of a polymeric diluent. Her subsequent years working in industry focused upon polymer characterization and the utilization of various analytical techniques to assist R&D, manufacturing, quality control and marketing. After graduation, she spent two years in the Applications Lab at T.A. Instruments (DE) working with thermal analysis. The following 10+ years were spent in the Corporate Analytical Lab at Millipore Corporation (MA) where she was responsible for various polymer characterization techniques such MDSC, TGA, DMA, GPC, mechanical testing, rheology, etc.

Nanotechnology in Connecticut

Two pieces of legislation regarding nanotechnology were recently enacted by the Connecticut legislature as part of House Bill No. 5846. Section 27 requires the Office of Workforce Competitiveness to conduct a feasibility study and business planning model leading to the establishment of a Connecticut Center for Nanoscale Sciences and Development that could provide a shared-use laboratory in one or more sites in the state to advance university research, industry application development and education. Section 91 authorizes the Department of Higher Education to develop a model nanotechnology curriculum.

For details see http://www.cga.ct.gov/2006/ACT/PA/2006PA-00187-R00HB-05846-PA.htm.

UConn Biodiesel Consortium

The UConn Biodiesel Consortium is a team of students and professors from IMS, Chemistry, Chemical Engineering, Plant Science, Marine Science, Economics, and Business. Our mission is to advance UConn's biodiesel research initiative for the greater good of the environment, and to help our nation gain energy independence.

The UConn Biodiesel Consortium and UConn Office of Environmental Policy held a half-day workshop at UConn on Tuesday May 9, 2006 in collaboration with the Eastern Connecticut Conservation District. It was attended by approximately 110 people from the emerging biodiesel industry in New England, members of the Connecticut State Government, UConn and Yale faculty, students and staff, and high school students.

The meeting began with presentations by UConn consortium members Richard Parnas (Polymers), Stan McMillen (Center for Economic Analysis), and Jim Stuart (Chemistry). Gus Kellogg (Greenleaf Biofuels) then illustrated the convergence of policy decisions and industry decisions critical to the development of this new industry. An open discussion followed the presentations, led by a panel consisting of Scott Gordon (Green Technologies, LLC), Paul Hoar (Agrifuels), Richard Hosley (Hale Hill Farm Biofuels), Gus Kellogg (Greenleaf Biofuels ™), Wayne Landry (UConn Motor Pool), and Ernie Tarca (Paines, Inc.). Our contingent of high school participants from the Greater Hartford Academy of Math and Science informed us of their work evaluating several types of algae for biodiesel production. After the discussion was brought to a close, with difficulty, all workshop participants went on tours of the pilot scale production facility in Chemical Engineering and the novel processing laboratory in Chemistry.

For more information about the Biodiesel Consortium and to download presentations from the meeting see http://biodiesel.engr.uconn.edu/home/index.php or contact Richard Parnas (rparnas@ims.uconn.edu).

Focus on Research

In each issue of this newsletter we profile one of the active research areas at IMS. In this issue we focus on the research being led by Rampi Ramprasad, Assistant Professor of Materials Science and Engineering.

Dr. Rampi Ramprasad received his B.Tech. in Metallurgical Engineering at the Indian Institute of Technology, Madras, India in 1990. He obtained his M.S. degree in Materials Science & Engineering at the Washington State University in 1992, and his Ph.D. degree also in Materials Science & Engineering at the University of Illinois, Urbana-Champaign in 1997. After a post-doctoral stint at the Department of Physics & Astronomy at the University of New Mexico, Albuquerque, he was with Motorola's R&D laboratories at Tempe, Arizona, as a Senior Staff Scientist from 1998-2001, and a Principal Staff Scientist from 2001-2004. He joined the Department of Materials Science and Engineering at the University of Connecticut as an Assistant Professor in the Fall of 2004. Dr. Ramprasad has authored or co-authored 22 peer-reviewed journal publications, filed 4 patents, and has presented numerous conference papers and invited talks.

Dr. Ramprasad's main research and teaching interests lie in the areas of Computational Materials Science and Materials Theory. His research interests are inter-disciplinary, spanning Materials Science, Physics, Chemistry and Electrical Engineering and include:

Surfaces/Interfaces

The International Technology Roadmap for Semiconductors (ITRS) has placed stringent demands on the next generation of logic, memory and RF capacitor devices, all of which require few to several nanometer thick dielectric films with high capacitance density. In response to these demands, the semiconductor industry is considering replacing conventional dielectric materials by other high permittivity (or high-k) dielectrics such as Ta2O5 and HfO2. However, electronic conduction through nanometer scale thin dielectric films and across metal-dielectric interfaces under an applied electric field both degrades the device performance and causes breakdown of the dielectrics in the long run. Furthermore, mechanisms underlying conduction & breakdown phenomena are numerous and have their origins at the electronic and atomistic level. Examples of such electronic / atomic level events include defect creation and dynamics, defect-defect interactions, and band offsets, Fermi level pinning & polarization at metal-dielectric interfaces. Present studies focus on performing detailed atomic level simulations, and using these results in meso-scale models of electronic transport and dielectric breakdown.

Nano-materials

A new perspective on nano-materials is to focus on the collective properties of an array of nano-particles rather than on the novel properties of each individual nano-element, while still carefully accounting for the physics underlying the "nano" nature of each of the constituents. Such a collective treatment requires using both mesoscale theories, such as the effective medium theory, and quantum electronic structure methods. Current investigations center around effective media composed of an array of nano-particles or nanotubes in a dielectric matrix. Methods are being developed to accurately calculate effective properties such as dielectric constant, permeability, etc, as a function of nano-material type (chirality in the case of nanotubes, for instance) and composition. Such effective media have applications in present day and future semiconductor, wireless telecommunications and imaging technologies.

Electromagnetic crystals, acoustic crystals and meta-materials

The next generation of semiconductor, wire-

less and opto-electronic devices will require complex signal manipulation, propagation and processing. Electromagnetic or acoustic waves can be manipulated in novel ways by systems that have periodic or quasi-periodic variations in their material properties such as permittivity, permeability or conductivity (in the case of electromagnetic crystals) and mechanical properties such as density and bulk modulus (in the case of acoustic crystals). Our studies will involve mapping the relationship between the physical and structural properties of these crystals on the one hand, and their electromagnetic and acoustic response on the other.

Others

In addition, Dr. Ramprasad's group will also be actively involved in (i) the development of advanced theoretical methods that bridge length & time scales by linking quantum mechanics based methods (such as density functional techniques) with phenomenological methods, (ii) developing efficient techniques to study electromagnetic and acoustic wave propagation in crystals and (iii) parallel computing.

A complete list of publications can be found at http://www.ims.uconn.edu/~rampi/publications.htm. Selected publications include:

1. R. Ramprasad and N. Shi, "Scalability of phononic crystal heterostructures", Appl. Phys. Lett. 87, 111101 (2005).
2. R. Ramprasad, P. Zurcher, M. Petras, M. Miller and P. Renaud, "Theoretical study of ferromagnetic resonance and eddy current losses in soft magnetic nanoparticle composites at GHz frequencies", J. Appl. Phys. 96, 519 (2004).
3. R. Ramprasad, "Mechanisms underlying leakage currents in metal-insulator-metal (MIM) capacitors: a phenomenological study", Physica Status Solidi. 239, 59 (2003).
4. R. Ramprasad and N. Shi, "Dielectric properties of nanoscale HfO2 slabs", Phys. Rev. B. 72, 052107 (2005).
5. N. Shi and R. Ramprasad, "Dielectric properties of ultrathin SiO2 slabs", Appl. Phys. Lett. 87, 262102 (2005).

For more information Dr. Ramprasad can be contacted at rampi@uconn.edu .

New Faculty

Rajeswari M. Kasi - Assistant Professor of Chemistry

Rajeswari M. Kasi will be joining IMS in August of 2006 in the Polymer Program as Assistant Professor of Chemistry. Dr. Kasi has most recently been a post-doctoral research associate at the University of Minnesota where she studied amphiphilic block copolymers in photovoltaic applications and block copolymer micelles as potential materials for filtration applications. Dr. Kasi received a Ph.D. in Polymer Science and Engineering from the University of Massachusetts, Amherst; a Master's degree in Chemistry from the Indian Institute of Technology, Madras, India and a B.S. in Chemistry from the University of Madras, Channai, India. In her research projects she seeks to synthesize, characterize, and, thereby, achieve a fundamental understanding of new polymer-based organic and hybrid materials comprising tailored architecture and functionality. Development of new synthetic methodologies, modification of existing synthetic routes, multidisciplinary approach to structure-property evaluation, and advanced characterization tools are the overriding factors to rational material design.

The general research focus areas will include steroidal based-biocompatible polymers, responsive materials composed of ionic polymer organogels, and mono or bimetallic inorganic organic hybrid materials. Harnessing self-assembly and supramolecular chemistry that occur in the neat and solution states of these well-tailored functional materials, we seek to better understand and resolve some of the issues currently observed in targeted drug delivery vehicles, polyelectrolyte membranes, sensors, and responsive materials.

Selected publications include:

1. Burkett, S. L., Soukasene, S. Milton, K. L., Welch, R., Little, A. J., Kasi R. M. and Coughlin, E. B., *Chem. Mater.*, 17, 2716-2723, 2005.
2. Kasi, R. M. and Coughlin, E. B., *Macromolecules*, 36, 6300-6304, 2003.
3. Kasi, R. M. and Coughlin, E. B., *Organometallics*, 22, 1534-1539, 2003.
4. Constable, G. S., Gonzalez-Ruiz, R. A., Kasi, R. M. and Coughlin, E. B., *Macromolecules,* 35, 9613-9615, 2002.
5. Zheng, L., Kasi, R. M., Farris, R.J., Coughlin, E.B., *J. Poly. Sci., Part A, Poly. Chem.,* 40, 885-891, 2002.

George Rossetti – Research Scientist, IMS

Dr. George Rossetti recently joined IMS as a Research Scientist. Prior to joining IMS Dr. Rossetti was a Visiting Scientist and Associate Research Professor in the Department of Materials Science and Engineering at Rutgers University. Prior to this Dr. Rossetti was Director of Functional Materials at Continuum Photonics Inc. in Billerica, MA, Senior Research Engineer at the NASA Center for Advanced Microgravity Materials Processing at Northeastern University; and a Senior Research Engineer at Norton Company Central Research, Saint-Gobain Corporation in Worcester, MA.

Dr. Rossetti received a Ph.D. in Solid State Science from Penn State University, a M.S in Material Science and Engineering and a B.S in Chemical Engineering both from Worcester Polytechnic Institute. Dr. Rossetti also was a post-doctoral research associate at the Princeton Materials Institute, Princeton University.

Dr. Rossetti's research interests include crystal growth, phase transformations, domain structures and physical properties of ferroelectric, ferroelastic and related active materials and their applications in electronic, optical and structural devices and systems.

Selected publications include:

1. G.A. Rossetti, Jr., W. Zhang and A. G. Khachaturyan, "Phase Coexistance Near the Morphotropic Phase Boundary in $PbZrTiO_3$-$PbTiO_3$ (PZT) Solid Solutions", Applied Physics Letters, 88, (2006).
2. W. L. Suchanek, M.M. Lencka, L.E. McCandlish, R.L. Pfeffer, M. Oledzka, K. Mikulka-Bolen, G.A. Rossetti, Jr., R.E. Riman, "Hydrothermal Deposition of <001> Oriented Epitaxial Pb $(Zr,Ti)O_3$ Films Under Varying Hydrodynamic Conditions", Crystal Growth and Design 5 (2005).
3. G.A. Rossetti, Jr., N. Maffei, "Specific Heat Study and Landau Analysis of the Phase Transition in PbTiO3 Single Crystals", Journal of Physics: Condesned Matter 17 (2005).
4. N. Maffei, G.A. Rossetti, Jr., "Float Zone Growth and Properties of Ferroelectric Lead Titanate", Journal of Materials Research 19 (2004).

Members Corner

In each newsletter we present short descriptions of one or two of our member companies. In this issue we focus on Techni-Met, Inc. We thank Kevin Goodwin of Techni-Met for this contribution.

Techni-Met, Inc.

Techni-Met, Inc. is a technology-based manufacturer of precision-coated materials, specializing in the vacuum deposition of inorganic thin films onto flexible continuous substrates. Our advanced processing techniques enable us to serve a broad range of industries with prototypes, product development and production services.

To meet a customer's most demanding specifications, Techni-Met offers unique coatings and material capabilities. We provide a wide range of standard and proprietary sputtering capabilities through the utilization of state-of-the-art process controls and unique vacuum sputtering systems. Techni-Met can deposit a variety of traditional and exotic metals, alloys, ceramics, and polymers onto most flexible substrates.

Through the utilization of advanced statistical process control (SPC) software, we are able to provide our customers with detailed quality information regarding their product. Techni-Met's SPC software provides invaluable data, which also ensures all equipment is operating within normal process variance.

Techni-Met, Inc. has added six new production systems over the last nine years and is still expanding. Our growth has been based on technology expansion and our continued growth in many different markets.

To provide products and services which meet or exceed customer specifications and needs, we are continually striving to improve performance to ensure customer satisfaction. Quality is the responsibility of every employee at Techni-Met.

For more information see: http://www.techni-met.com/.

Patents Granted, Applications and Licenses (January through June 2005)

Dr. Dan Scola, Research Professor, Institute of Materials Science, and C. D. Simone (former IMS student) were granted a patent on "Low Temperature Melt Processable High Temperature Polyimides."

Drs. Fotios Papdimitrakopoulos, Professor, Chemistry and Associate Director, IMS, and Harris Marcus, Professor MS&E/CMBE & Director, Institute of Materials Science**,** were granted a patent entitled "Apparatus and Method for Fabrication of Photonic Crystals."

Greg Sotzing, Associate Professor, Chemistry, has applied for a patent entitled "Substituted Thieno[3,4-B]thiophene Polymers, Methods of Making, and Use Thereof."

In this same period the University has granted licenses of three patents by faculty members of IMS. Optoelectronics Systems Consulting, Inc. has licensed the patent "Wireless Power Supply for Implanted Medical Devices" from Professors Faquir Jain, Electrical Engineering; Diane Burgess, Pharmaceutical Science; and Fotios Papadimitrakopoulos, Professor, Chemistry and IMS Associate Director. Air Products and Chemicals, Inc. has licensed a patent in the field of conductive polymers from the work of Greg Sotzing, Associate Professor, Chemistry. Advanced Power Systems International has licensed patented work by Steve Suib, Professor and Department Head, Chemistry, in metal alloys as catalysts for fuel and as biocides.

Department Seminars

Fall seminar schedules have not been finalized at this time. The preliminary Polymer Program seminar schedule is on page 11. This information, and the seminar schedules for most departments, will also be available on the Web (Materials Science and Engineering: http://www.engr.uconn.edu/cmbe/page.php?id=seminar&pid=seminars; Polymer Program: http://www.ims.uconn.edu/poly/component/option,com_wrapper/wrap,Seminars/Itemid,91/. Abstracts of seminars are usually available about a week in advance. We can also put you in touch with the faculty member sponsoring the seminar to learn more about the specific seminar of interest. We suggest you call before attending to be sure the seminar has not been canceled due to illness or weather.

Fall Semester Starts

Fall semester classes start August 28, 2006. Some courses that may be of interest include the following.

CHEM-380	Polymer Synthesis	Kasi
CHEM-381	Polymer Physical Chemistry	Seery
CHEM-382	Polymer Characterization I	Sung
CHEG-351	Polymer Physics	Dobrynin
CHEM-394-1	Conducting Polymers	Sotzing
BME-273	Advanced Biomaterials	Wei
MMAT-320	Materials Joining	Kattamis
MMAT-322	Materials Characterization	Aindow
MMAT-301	Thermodynamics of Materials	Brody
MMAT-317	Electrical and Magnetic Properties of Materials	Alpay
MMAT-320-002	Investigation of Special Topic: Thin Films & Coatings	Huey

IMS Short Course

Plans are in development for next summer's short course. Tentatively we plan "Failure of Materials" with Drs. Ezrin and McEvily as instructors. We welcome your suggestions for future short courses. You will receive detailed information in the spring. All Associates Program member companies will receive one reduced price registration.

Technology Incubation Program

The University of Connecticut Technology Incubation Program (TIP) aims to accelerate the success and viability of entrepreneurial companies by leveraging university technologies and facilities, and providing cost-effective business and research services as well as access to the diverse and unique resources of a world-class university. The TIP, with the Center for Science and Technology Commercialization and the UConn R&D Corporation, is part of the University of Connecticut Office of Technology Commercialization. The three OTC programs provide a variety of resources to support entrepreneurs as they begin patenting and licensing and move to funding and commercialization.

For complete details see http://www.tip.uconn.edu/brochure.pdf.

LATICRETE INTERNATIONAL Celebrates 50th Anniversary

LATICRETE INTERNATIONAL (http://www.laticrete.com/), member of the IMS Associates Program, recently celebrated its 50th anniversary as a leading producer of innovative tile and stone installation systems in grand style during Coverings 2006 in Orlando, Florida.

Henry M. Rothberg, Laticrete founder and chairman emeritus, delivered a speech in which he thanked Laticrete's employees, both past and present, and the Bethany, CT-based company's base of loyal customers for their support.. The gala event was a great chance for Laticrete to gather with all of its friends, distributors, general contractors, associates and representatives to share in the success and strengthen the bonds that Laticrete has built over the last five decades.

For the complete article see: http://www.stoneworld.com/CDA/Articles/Industry_News/.

POLYMER SEMINARS
Fall Semester 2006

(Preliminary Announcement)

September 1	**"Novel Nanostructures in the Self-Assembly of Chiral Block Copolymers"** Professor Rong-Ming Ho, National Tsing-Hua University, Taiwan
September 22	**"Relating Polymer Rheology and Miscibility to Chemical Architecture"** Dr. David Lohse, ExxonMobil Research & Engineering
September 29	**"Variable Bandgap Conjugated Polymers as Electrochromics and Photovoltaics"** Professor John Reynolds, University of Florida
October 6	**"The Effect of Melt Time and Temperature on the Morphology of PTFE"** Professor Phillip Geil, University of Illinois
October 12 (Thursday)	**"Recent Advances in the Controlled Radical Polymerization of Fluoroalkenes and Well-Architectured Fluoropolymers therefrom"** Professor Bruno Ameduri, CNRS, Ecole Nationale Supérieure de Chimie de Montpellier, France
October 27	**"Title TBA"** Professor Shaw Ling Hsu, University of Massachusetts at Amherst
November 17	**"Layered Polymeric Systems by Forced Assembly"** Professor Eric Baer, Case Western Reserve University

All seminars are held on Fridays at 11:00 AM in IMS Room 20, unless noted otherwise.
Coffee will be served at 10:45 AM outside the seminar room.
For more information, please contact YH Chudy at ychudy@ims.uconn.edu, (860) 486-3582 or visit *www.ims.uconn.edu*.

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We're on the Web!
www.ims.uconn.edu/assoc

Sample Preparation

In many projects that the Associates Program deals with, such as adhesion and coatings, surface analysis techniques are extremely important. The techniques used for such analysis, particularly GC/MS, Auger electron spectroscopy (AES) and x-ray photoelectron spectroscopy (XPS) are extremely sensitive to small amounts of material on the surface. It is important to make efforts not to contaminate these surfaces during sample preparation, collection and shipment. **Shipment in common plastic bags should be avoided**! Common plastic bags typically contain significant amounts of additives used to prevent the plastics from adhering to themselves and other materials. These additives will migrate to the sample during shipment and at best make interpretation difficult and sometimes impossible. It is much better to ship such samples in common kitchen aluminum foil (not industrial aluminum foil which is often coated with an oil or other release agent). Samples can also be shipped in glass containers with aluminum foil over the opening under the cap.

Alternatively special polyester bags that do not contain such additives can be purchased. One source of such bags is the Kapak Corporation, 5305 Parkdale Drive, Minneapolis, MN 55416, 612/541-0730. Typical price is about $200 per thousand depending on the exact size. Be sure to specify non-contaminating/non-plasticized material.