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# ADVANCED MATERIALS AND POLYMER SCIENCE

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International Conference and Expo on

# SEPARATION TECHNIQUES

October 19-20, 2018 | Tokyo, Japan

# DAY 1

## Scientific Tracks & Abstracts

# Day 1

# SESSIONS

October 19, 2018

**Separation Methods and Techniques | Applications of Separation Techniques | Polymer Science and Technology | Polymer Science and Technology | Nanopolymers and Nanotechnology**

## Session Introduction

**Session Chair**
**Md. Akhtaruzzaman**
Universiti Kebangsaan Malaysia, Malaysia

Title: **DE wave power generators**
**Makoto Takeshita,** Zeon Corporation, Japan

Title: **A quantum connection in the periodic and roberts-janet tables**
**John Owen Roberts,** Open University, UK

Title: **Online multiple-dimensional liquid chromatography by a single column**
**Xindu Geng,** Northwest University, China

Title: **3D-Printable SEBS based ternary blends with tunable shape memory effect**
**Jiachun Feng,** Fudan University, China

Takeshita M et al., Mater Sci Nanotechnol 2018, Volume 2

# DE WAVE POWER GENERATORS

**Takeshita M[1], Waki M[2], Chiba S[3], Uejima M[1], Arakawa K[1], Ueno M[1] and Fujita K[4]**
[1]Zeon Corporation, Japan
[2]Wits Inc., Japan
[3]Chiba Science Institute, Japan
[4]Tohoku University, Japan

Increase in world population and the accompanying surge in demand for energy, food and water, as well as the sudden increase in energy consumption caused by recent industrial development and betterment of life standards in newly developing countries will accelerate global warming. Among the diverse measures proposed to meet our energy needs, the use of renewable energy is receiving increasing attention. Especially, the wave power generation has attracted attention as one of useful utilization methods for ocean energy. However, the conventional wave generators are large, expensive, and unable to efficiently generate electric power with small amplitude waves, limiting their widespread usage. To solve these problems, we will discuss the possibilities for a wave power generator using dielectric elastomer (DE) artificial muscle recently developed as a novel method for harvesting renewable energy. DE artificial muscle is a new smart material technology with characteristics and properties not seen in other materials. The basic element of DEs is a very simple structure comprised of thin polymer films (elastomers) sandwiched by two electrodes made of a stretchable material. DEs can operate as an electrically-powered actuator. When a voltage difference is applied between the electrodes, they are attracted to each other by electrostatic forces leading to a thickness-wise contraction and plane-wise expansion of the elastomer. The use of DE actuator in the reverse mode, in which deformation of the elastomer by external mechanical work is used to generate electrical energy, has been gaining more attention. As DE is very light, inexpensive, and easily formed into multiple layered structures, it can make a very simple and robust direct drive wave power system that is economically viable. DE has moved now from the research and development stage to the commercial domain with research and development on practical applications, and furthermore to the mass production stage.

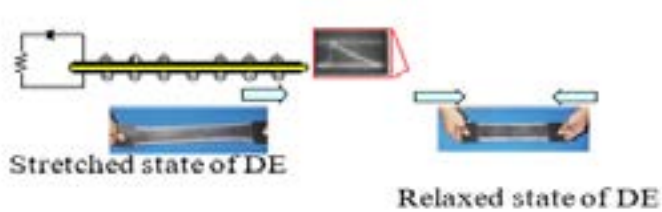


Figure.1: Operating principle of dielectric elastomer power generation; the DEG is basically a stretchable capacitor. If a charge is applied to the DEG in the stretched state, then work done by the contracting elastomer is converted into electrical energy (as illustrated by the voltage across the resistor in the right illustration).

## BIOGRAPHY

Takeshita M has completed his graduation from the Tokyo Institute of Technology Interdisciplinary Graduate School of Science and Engineering in 2003 with a master's degree in Engineering studies. He is currently a Senior Researcher at the CNT Laboratory Materials Research Team, Research and Development Center, Zeon Corporation. He wrote many papers related to CNTs.

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John Owen Roberts, Mater Sci Nanotechnol 2018, Volume 2

# A QUANTUM CONNECTION IN THE PERIODIC AND ROBERTS-JANET TABLES

**John Owen Roberts**
Open University, UK

The time independent quantum states in the Periodic Table are inverted to accommodate spatial variation relative to the nucleus. From groups U (1) x SU (2) x SU (3) including the Pauli principle the mathematics of quantum physics from the standard model produces two sets of time independent quantum states in the gauge potential n(n+1) and n(n-1) where n is the principal quantum number. Oscillations between these states result in a one-to-one mapping between this quantum mechanical table and the Roberts-Janet nuclear periodic table by interpretation of positive n values for condensed matter and negative n values for plasma prior to fusion. A model of string theory at the nuclear end of the table is discussed merging into quantum loop gravity at the condensed matter end of the table. Having discussed a possible route back to the big bang, the structure of both the Periodic and Roberts-Janet Tables is analysed including repeating patterns of 8,18,32 and the energy orbitals of the transition and lanthanide/actinide elements.

## BIOGRAPHY

John Owen Roberts is graduated in 1969 with a BSc (Hons) Physics from the University of Liverpool. He has been an Open University Tutor for 30 years and a private tutor of Maths and Science.

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Note:

Xindu Geng et al., Mater Sci Nanotechnol 2018, Volume 2

# ONLINE MULTIPLE-DIMENSIONAL LIQUID CHROMATOGRAPHY BY A SINGLE COLUMN

**Xindu Geng[1], Minghui Geng[2]** and **Yongjun Lu[2]**
[1]Northwest University, China
[2]Xi'an Aolan Science and Technology Development Company, China

Multiple-dimensional liquid chromatography (mD-LC) has been a power tool for substances in a complex sample, especially for fast separation of biopolymers in small scale in proteomics and drug purification in industrial scale. For an interface transfer between two columns, both offline and online manners can be adopted, the former can operate large sample, but very slowly; while the latter is very fast but only can transfer volume solution in μL scale with accounting of 1/10 to 1/100 of the fraction from the previous separation mode. A problem with the both is that it is hard simultaneously to satisfying with high sample size, high resolution, and high speed (three high). My presentation is to solve the request of the "three high" by employing the combination of steady-region/migration-region optimization of two variable theory of substance under gradient elution, a suitably sized chromatographic cake, and a fully automatic multiple liquid chromatograph. A key point is that the SR can be used as an operation space to expedite protein separation. Buffer exchange, collection of fractions, pre-concentration of target proteins, resampling, and so on, which are typically performed offline in hours or even days, but it can be carried out in minutes or even seconds in this operation space. A crude extract containing 20 % CBD was purified to purity of 99% by online 3D-LC (RP/RP/RP) with only a single column in less 90 min.

## BIOGRAPHY

Xindu Geng has graduated from Northwest University (NWU, Xi'an) and became a Faculty Member of Department of Chemistry of NWU, and then a Faculty Member University of Minnesota in 1982-1983. He is the Visiting Professor of Purdue University separately at Department of Biochemistry in 1982-1984 and Department of Chemistry in 1995-1996, as well a Visiting Professor of Chemistry Department of Creighton University in 2001. He is the Director of Institute of Modern Separation Science of Northwest University. He has published more than 300 papers in reputed journals.

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Note:

Jiachun Feng, Mater Sci Nanotechnol 2018, Volume 2

# 3D-PRINTABLE SEBS BASED TERNARY BLENDS WITH TUNABLE SHAPE MEMORY EFFECT

**Jiachun Feng**
Fudan University, China

Heat-activated shape memory polymers (SMPs) have received great attention in both industry as well as academia throughout the last years. Traditional dual SMPs can memorize only one temporary shape, while multiple SMPs can memorize more than one temporary shapes. Unlike the above two categories of SMPs, tunable SMPs are not limited by the number of temporary shapes and have capability to adjust deformation temperatures optionally. Additive manufacturing, also known as three-dimensional (3D) printing, is a remarkable burgeoning technique which drives major innovations in the fields of manufacturing, architecture, healthcare and education. To date, 3D printing with SMPs have attracted lots of interest. In comparison with current 3D-printable dual SMPs or multiple SMPs, 3D-printable tunable SMPs have possibility to implement more complex and sequential shape change process vividly in a pre-programmed way, which is of great significance for applications such as flexible electronics, electrical actuators, intelligent biomedical scaffolds, etc. In this work, we reported a facile strategy to fabricate tunable shape memory polymer blends with the feasibility of 3D printing simultaneously. A series of tunable SMPs consist of styrene-b-(ethylene-co-butylene)-b-styrene (SEBS) ternary blends, exhibiting good dual, triple and quadruple shape memory effect, moreover, such shape memory behaviors can be tuned in a broad temperature range via the selection of deformation temperatures alone, demonstrating that this blend have good tunable shape memory effect. This tunable SMPs are easy to be processed and suitable for a fused deposition modeling 3D printer. Considering the inexpensive and environmental sources as well as easy processing, our reported strategy has great potential in many application fields.

## BIOGRAPHY

Jiachun Feng has completed his PhD from Institute of Chemistry, Chinese Academy of Sciences (CAS), China. He is the Professor of Fudan University, China. He has over 100 publications focus on the structure-property relationship and properties improvement of polymer materials.

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# DAY 2

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# SESSIONS

October 20, 2018

**Polymer synthesis and Polymerization | Novel Separation Techniques in Chemistry**
**High Performance Liquid Chromatography | Physics and Chemistry of Materials**

## Session Introduction

**Session Chair**
**Marine Michel**
Imperial College
UK

Title: **Contribution to the improvement of the properties of $SiO_2$- based polymer composites materials**

**Abdelhamid Oufakir,** Université Cadi Ayyad Marrakech, Morocco

Title: **Construction of road map for advanced functional materials for removal of hazardous pollutants in air and comparison of Figure of Merit (FOM)**

**Ki-Hyun Kim,** Hanyang University, South Korea

Title: **Enantioselective polymeric composite membrane for chiral separation of racemic mixtures**

**Marine Michel,** Imperial College, UK

# CONTRIBUTION TO THE IMPROVEMENT OF THE PROPERTIES OF SIO2- BASED POLYMER COMPOSITES MATERIALS

**A Oufakir[1,2], L Khouchaf[2], M Elaatmani[1] and A Zegzouti[1]**
[1]Université Cadi Ayyad Marrakech, Morocco
[2]Lille Université, France

In recent years, silica has found interesting applications in a variety of disciplines including concrete, catalysis, clean technology, separations science and microelectronics devices. Silica is also a good candidate as filler in composite polymers. In fact, polymer composites are the advanced materials alternative to traditional materials such as metals or ceramics and consist of at least two constituents of different phase, one of them being continuous polymeric matrix phase and other is reinforcements (fibers, filler). Interaction between the filler and the polymer matrix is a key of the properties of the polymer composites. The control of the interface of the filler is the very important without the addition of chemical agent. Although it is challenging to determine the true surface of SiO2 compounds to avoid hazardous additions. The specific aim of this work is to study the dependence between structure, surface state and reactivity of silica for different heterogeneous SiO2 compounds and evaluate the behavior of their surface subject to chemical stress, to increase reactive ability of theirs surfaces to be able to interact with the molecules of modifiers. The surface morphology of silica is examined by variable pressure scanning electron microscope (VP-SEM) and showed the original fibrous surface of silica quartz. The FTIR frequency shift of the bridging oxygen stretching vibration Si–O–Si is observed and the intensity ratio between Si-OH band and Si-O-Si increases is determined. Furthermore, x-ray diffraction showed that the quartz lattice was conserved during the treatment with a shift of the main peak 101 in agreement with the infrared results on the Si-O-Si peak shift and the increase in the intensity ratio of Si-OH/Si-O-Si. The phase obtained is used to prepare polymer composites with high thermal and mechanical performances.

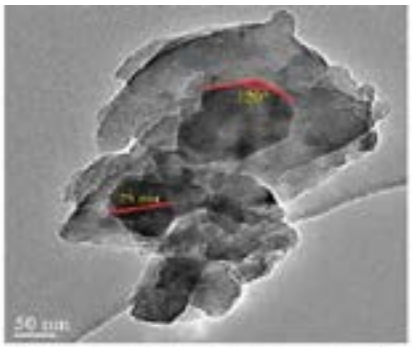


Fig. 1. Transmission Electron Microscope image of SiO2-1 sample.

Recent Publications

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## BIOGRAPHY

A Oufakir has completed his Process Engineer's degree and enjoyed a successful two-year experience in teaching Physics at secondary schools in Morocco. He is pursuing PhD degree at Cadi Ayyad University of Marrakech in collaboration with the IMT Lille Douai in France.

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# CONSTRUCTION OF ROAD MAP FOR ADVANCED FUNCTIONAL MATERIALS FOR REMOVAL OF HAZARDOUS POLLUTANTS IN AIR AND COMPARISON OF FIGURE OF MERIT (FOM)

**Ki-Hyun Kim** and **Jan Szulejko**
Hanyang University, South Korea

To effectively remove gaseous pollutants from air using sorbents, a thorough knowledge of the actual sorption performance is needed at ambient conditions rather than unrealistically high-pressure conditions, as is commonly presented in the literature. To this end, the sorbent capacities of gaseous pollutants including benzene, formaldehyde, ammonia, hydrogen sulfide, etc. were evaluated at a constant sorbent bed inlet pressure (e.g., 50 ppm or ~5 Pa), room temperature (298 K), a fixed flow rate (50 mL min-1), and equal outlet sampling intervals (5 min). The adsorption patterns of various pollutants were investigated against diverse materials including advanced functional materials like metal organic frameworks, graphene materials, and conventional sorbents like activated carbons for references. The experimental results obtained for various pollutants by the tested sorbent materials were further assessed by the Langmuir, Henry's law, Freundlich, Dubinin-Radushkevich and Elovich isotherm models. The linearized Langmuir adsorption isotherms were evaluated in various respects to help develop a road map for pollutant removal by diverse materials. Further, the best figure-of-merit data for each material was then assessed based on a high 10% breakthrough volume (BTV) and the actual cost involved for real-world applications.

## BIOGRAPHY

Ki-Hyun Kim was at Florida State University for an MS (1984-1986) and at University of South Florida for a PhD (1988-1992). He was a Research Associate at ORNL, USA (1992 to 1994). In 1999, he joined Sejong University. In 2014, he moved to the Department of Civil and Environmental Engineering at Hanyang University. His research areas broadly cover the various aspects in the field of air quality and material engineering in connection with advanced novel materials like coordination polymers. He was awarded as one of the top 10 National Star Faculties in Korea in 2006. He is a serving Editorial Board Member of several journals (e.g., *Environmental Research, Atmospheric Pollution Research, and Sensors*). He has published more than 530 articles, many of which are in leading scientific journals like *Chemical Society Reviews, Progress in Material Science, Progress in Polymer Science, Coordination Chemistry Reviews and Trends in Analytical Chemistry*.

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# ENANTIOSELECTIVE POLYMERIC COMPOSITE MEMBRANE FOR CHIRAL SEPARATION OF RACEMIC MIXTURES

**Marine Michel[1,2], Bradley P Ladewig[1] and Matthew R Hill[2]**

[1]Chemical Engineering, Imperial College London, UK

[2]CSIRO Manufacturing, Australia

Many pharmaceuticals exist as a mixture of two enantiomers (optical isomers). Chiral separation of enantiomers is attracting interest as the demand for enantiopure pharmaceuticals is growing dramatically. The biological response such as toxicological behavior, therapeutic activity, or immune response is strongly dependent on the configuration of a given molecule, including its chirality and two enantiomers can display a different optical activity. However as they have the same physico-chemical properties, their separation is a challenging task but is crucial as the incorrect enantiomer of the drug can offer no curative effect or even be detrimental. Optical resolution of racemic mixtures has been broadly studied by various methods including chromatography, diastereomer formation and preferential crystallization. Among these techniques, membrane processes are seen as serious alternatives to established chiral separation technologies, especially since they have lower energy costs, are continuous, eco- friendly, economical and are easy to scale up. In optical resolution, the membrane acts as a selective barrier and transports one of the paired enantiomers preferentially because of a stereo-specific interaction between enantiomers and chiral recognition sites present in the membrane. The chiral recognition can be introduced in the membrane by various means such as incorporation of chiral selectors, grafting of chiral side chains in the polymer, chiral backbone polymer etc. Most studies of chiral separation membranes have been performed using dialysis method, where the driving force for the permeation and separation of chiral chemicals is the concentration difference between feed and permeate. With this method the concentration of the final product is more dilute than that of the feed solution, and permeation is extremely slow. Ultrafiltration or nanofiltration chiral separation membranes, using a pressure-driven force as the driving force could be the answer to these disadvantages. This work focuses on membrane-based enantioseparation technique, performed in pressure driven separation mode, which has the potential for large-scale production of enantiopure compounds and could pave the way for many more commercial applications satisfying the considerable demand for large-scale chiral separation techniques.

## BIOGRAPHY

Marine Michel is a Chemical Engineer (ENSIACET, France, 2015) and graduated with a MSc in Chemical Engineering from Imperial College, London, UK (2015). She is now pursuing a PhD degree in membrane separation process at Imperial College London, UK and is a member of the Barrer Center.

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