

SIS2006 Poster Presentations

From Singapore

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	Functionalised specialty polymers
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	Multi-layered Biodegradable Polymer Structure

From Mitsui

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Nano-Crystal Structure Controlled Elastomer
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Excerec: Miracle Processing Aid
Organic-Inorganic Hybrid Coatings
Orientation Control Technique of Organic Molecules
Functional Polymers Created by New Catalysts

IMRE: Institute of Materials Research & Engineering

ICES: Institute of Chemical & Engineering Sciences

IHPC: Institute of High Performance Computing

NUS: National University of Singapore

NTU: Nanyang Technological University

High Performance Processing Tape ICROS™

Yoshihisa SAIMOTO¹⁾ and Toshiya URAKAWA²⁾

Electronics Materials Division¹⁾ and Electronics & Engineered Materials Laboratory²⁾, Mitsui Chemicals, Inc.

Abstract

ICROS™ tape protects the circuit-formed surface in grinding the non-circuit-formed surface for the semiconductor wafer and then has been used in the Semiconductor manufacturing process. The function like the following is requested for ICROS™ tape.

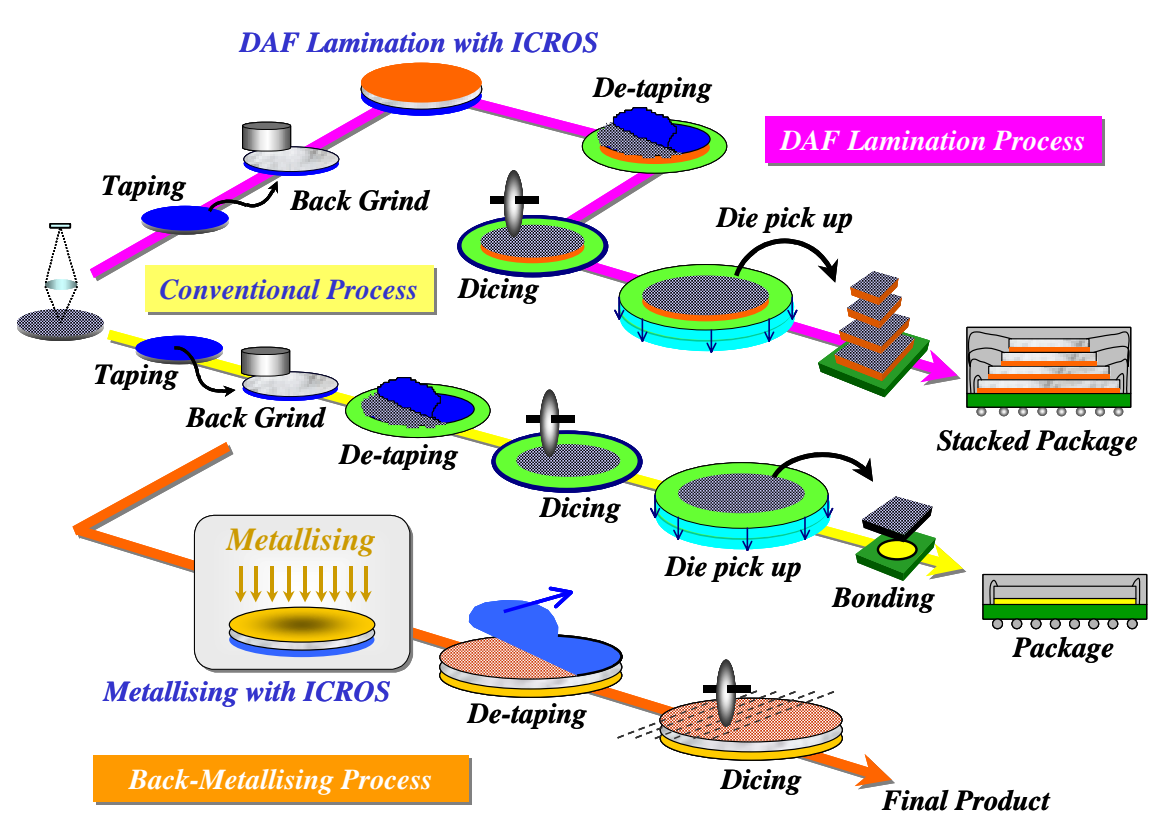
- Conventional Low contamination after de-taping, Cushion during grinding

Recently the thinner wafer is considered for developing the high-density package. ICROS™ tape is requested the support (the anti-warpage) and the heat resistance during the new process. The requested function for each process is the following.

- DAF Lamination Support for the ground wafer, Heat Resistance in laminating DAF
- Back-Metallising Heat Resistance and Low out-gassing in spattering some metals

Our next target is to develop the processing tape with the high-value added based on the material design acquired for ICROS™ tape. MCI can propose the suitable processing tape for your new technology.

ICROS™ tape usage method and MCI proposal for the new process



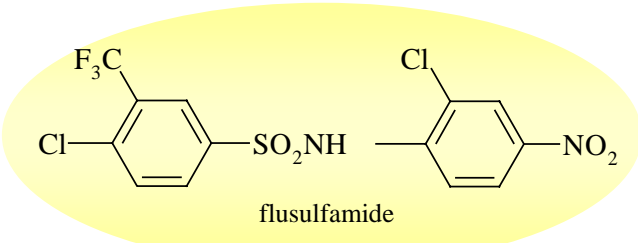
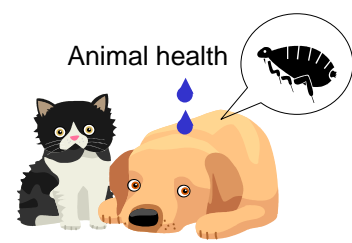
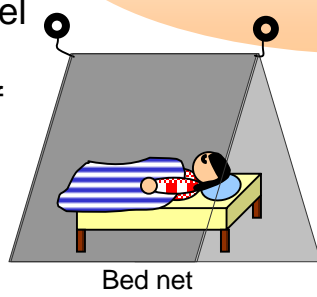
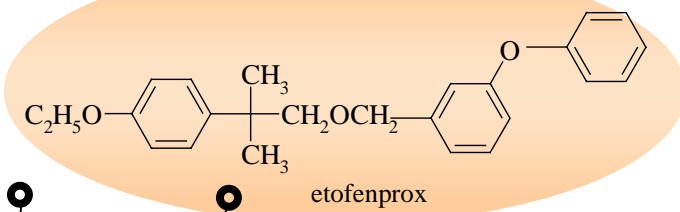
Mitsui's agrochemicals -high performance- around the world.

Naoko Yasui

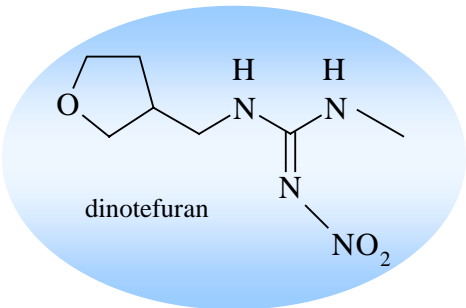
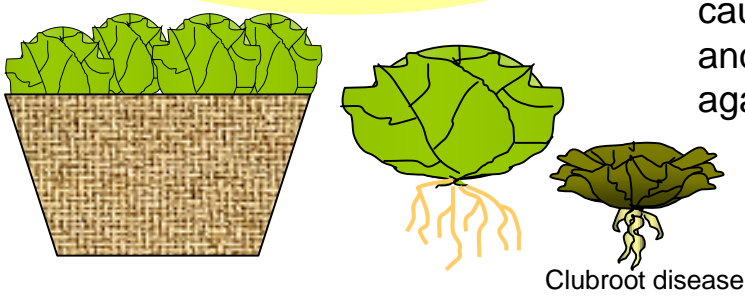
Functional Chemicals Laboratory, Mitsui Chemicals, Inc.

Etofenprox, Flusulfamide, Dinotefuran are the representative agrochemicals that developed by Mitsui Chemicals, Inc. These compounds has unique character and high performance, so they are used around the world.

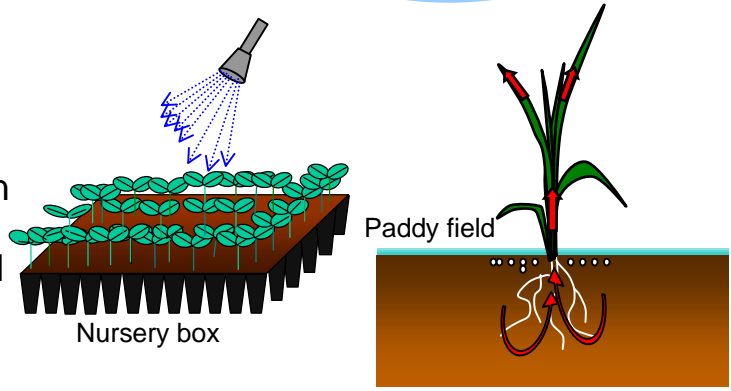
Etofenprox belongs to synthetic pyrethroid insecticides group, but it includes an ether unit in structure instead of an ester unite. It has a high safety level for warm-blooded animals,so it could be used for animal health and prevention of epidemics.Synthetic pyrethroids before etofenprox had high toxicity to fish so it couldn't be used in paddy fields. But etofenprox overcomes this weakness.



Flusulfamide is a soil fungicide. It shows an excellent efficacy against the clubroot disease of Brassicaceae crops caused by *Plasmodiophora brassicae*, and shows high antimicrobial activities against some other plant pathogens.



Dinotefuran was successfully discovered as a new neo-nicotinoid, with no pyridine or thiazole ring with a halogen atom, by choosing acetylcholine as a lead compound. These moieties had been considered indispensable for preceding neo-nicotinoids. Various new kinds of applications have been developed by using its water solubility and splendid systemic and penetration action in plants.



PDP Optical Filter FILTOP™

Satoru Okada

Information Materials Division, Mitsui Chemicals, Inc.

Tomoyuki Okamura

Electronic & Engineered Materials Laboratory, Mitsui Chemicals, Inc.

Abstract

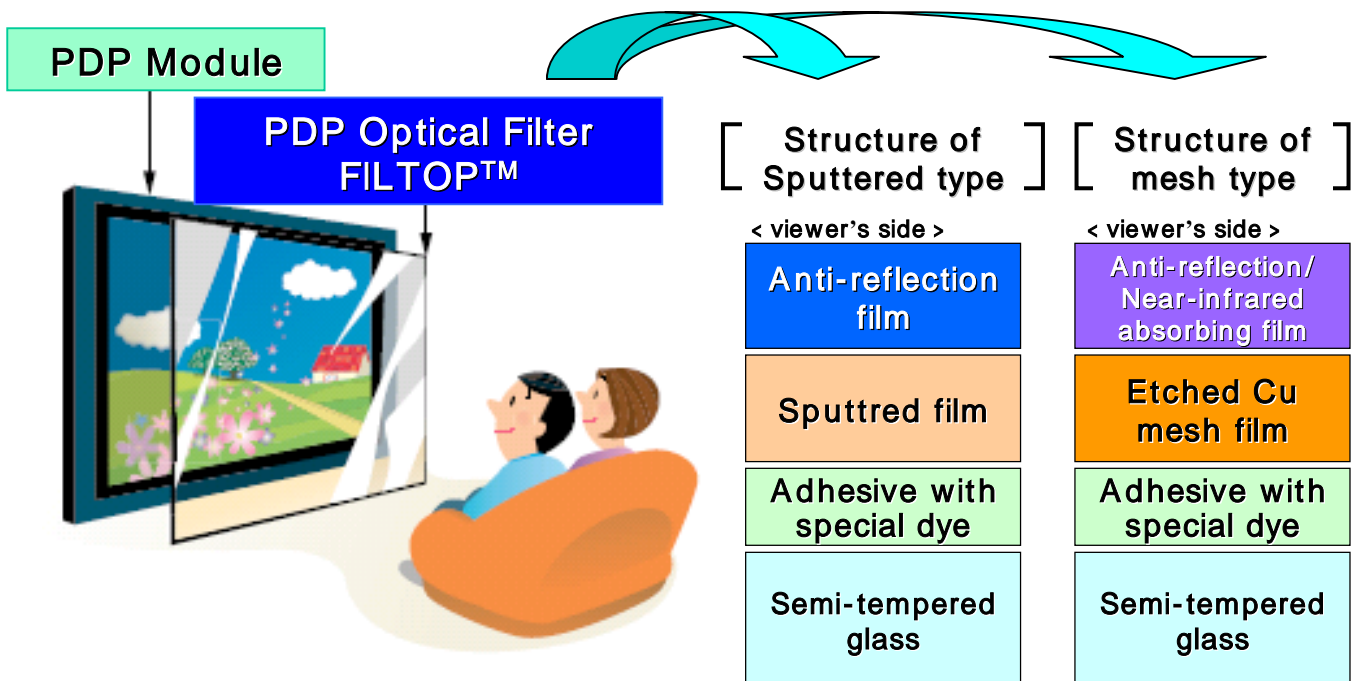
Plasma Display Panel (PDP), a leading product for large-sized flat panel display, is now rapidly spreading into the TV and public display market.

PDP essentially requires a filter with such features as follows.

- Improvement of color and picture quality by controlling transmission spectrum
- Shielding of electro-magnetic radiation from PDP panel
- Blocking of near-infrared light from PDP panel

Since the dawning of PDP market at mid-90's, Mitsui Chemicals has been a leader in optical filter development providing various solutions by combining our unique technologies.

- Dye synthesis technology to enable the customized spectrum
- Highly productive roll-to-roll multilayer sputter coating technology
- Highly productive roll-to-sheet lamination technology



Nucleosides:

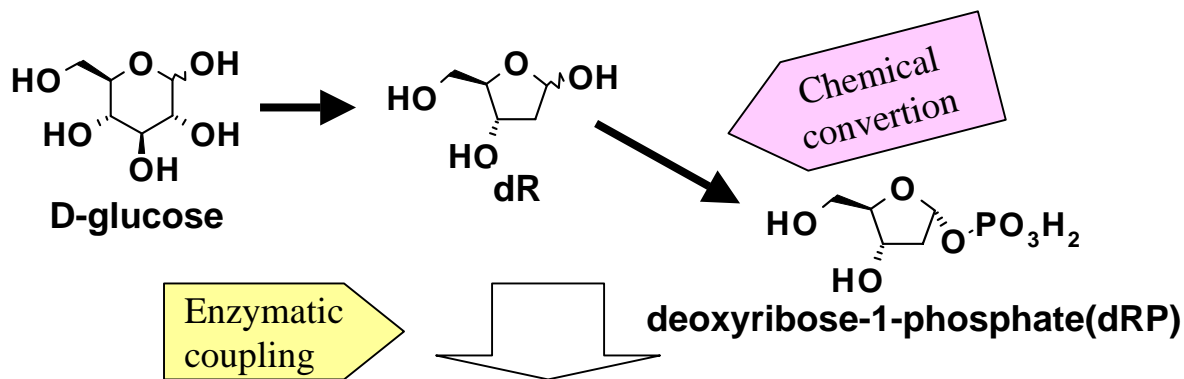
A Novel Chem-Enzymatic Hybrid Process

Hironori Komatsu¹, Toshihiro Oikawa¹, Hiroki Ishibashi², Hirokazu Awano², Tadashi Araki¹
¹Catalysis Science Laboratory and ²Process Technology Laboratory, Mitsui Chemicals, Inc.

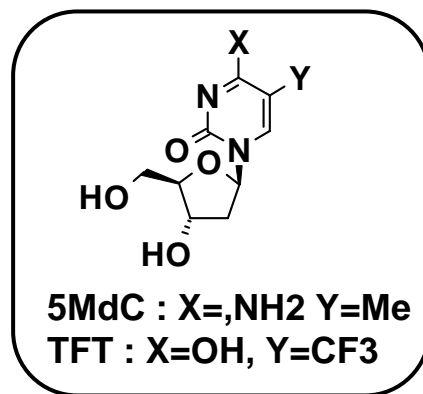
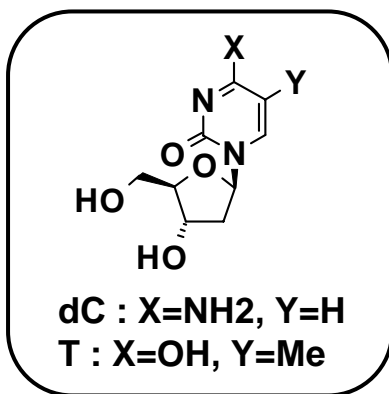
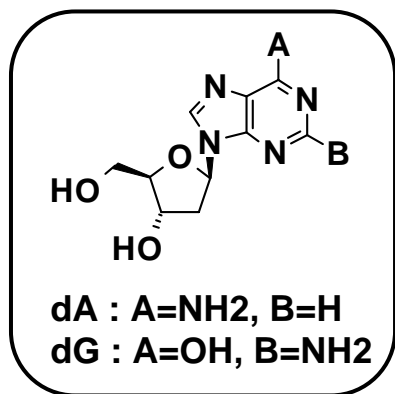
In a world first, Mitsui Chemicals has developed a commercial-scale synthetic process for deoxynucleosides.

Three sophisticated technologies enable us to make deoxynucleosides very effectively.

- 1) Stereo controlled synthesis of sugar phosphates by crystallization-induced asymmetric transformation.
- 2) Stereo selective coupling of sugar phosphates with base by a smart enzyme.
- 3) development of a new enzyme for the enzymatic synthesis.



Four natural type deoxynucleosides and other analogues are available!



5'-O-Dimethoxytrityl compounds are also available as building blocks for Oligo.

Our experienced quality assurance system offers you high quality, clear impurity Profiles and BSE free materials for pharmaceutical application.

Super Polyolefin TPX™ for Release and Heat Resistant Application

Toshiyuki Hirose

Functional Polymeric Materials Laboratory, Mitsui Chemicals, Inc

Abstract:

TPX™ is the trade name for Mitsui’s specialty polyolefin. Our spelling of **TPX™** stands for “Transparent Polymer X”. It has excellent transparency, heat resistance, gas permeability and low surface tension. These properties are derived from its unique molecular and crystalline structure. **TPX™** is used in a broad range of application areas, including industrial materials such as release film, release paper, sheath and mandrels used for high-pressure rubber hose, LED molds, food packaging materials such as wrap film, micro wave oven ware and medical material such as syringe, analyzing cell for blood diagnosis.

1. Production

TPX™ consist of 4-methyl pentene-1 produced by dimerization of propylene. Ziegler-Natta catalyst is used for the polymerization.

2. Molecular structure and properties

TPX™ has bulky Iso-butyl side chain that provides unique properties to the polymer. It restricts the movement of polymer main chain and make space in inter and intra molecular structure. The restriction of the movement of polymer main chain results in high melting temperature and inter/intra molecular space causes low surface tension and high gas permeability.

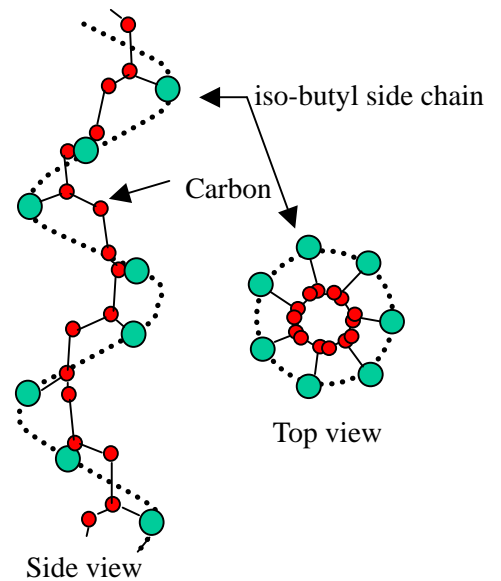


Fig 1. Crystalline structure of TPX™

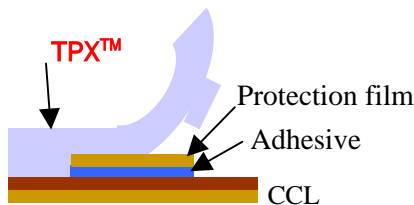


Fig 2. Release film for PCB

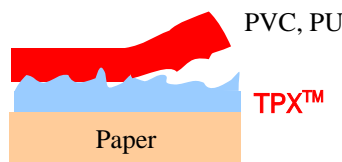


Fig 3. Release paper for synthetic leather

Example releasing material

3. Application

Major application of **TPX™** is the releasing materials for its low surface tension comparable to fluoropolymers. Because of this, **TPX™** is used in the areas of release film for printed circuit board, release paper and others

Organic-inorganic Hybrid Coatings with High Gas Barrier and Abrasion Resistance

Toshihiko Takaki, Katsunori Nishiura, Kazuyuki Fukuda
Material Science Laboratory, Mitsui Chemicals, Inc.

Abstract

We have developed a new organic-inorganic coating material which gives polymer films both abrasion resistance and a high oxygen barrier property even in high humidity conditions. The transparent film is obtained (Figure 1) and a well-dispersed structure is observed in the TEM (Figure 2). IPN (Interpenetrating Polymer Network) structure is formed by introducing the interaction between the organic and inorganic components. When the silica content exceeds 50%, closely packed silica networks are formed which suppress polymer mobility (Scheme 1), and this prevents gas permeation at high humidity and also improves abrasion resistance (Table 1).

This coating material can be cured at a relatively lower temperature, so it can realize high gas barrier performance for polyolefin, nylon, poly(ethylene terephthalate) and other polymer films only by a wet coating process.



Figure 1. Pictures of hybrid coatings on PET film

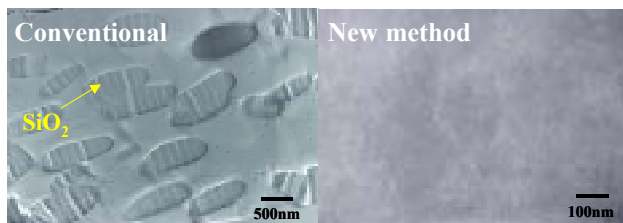
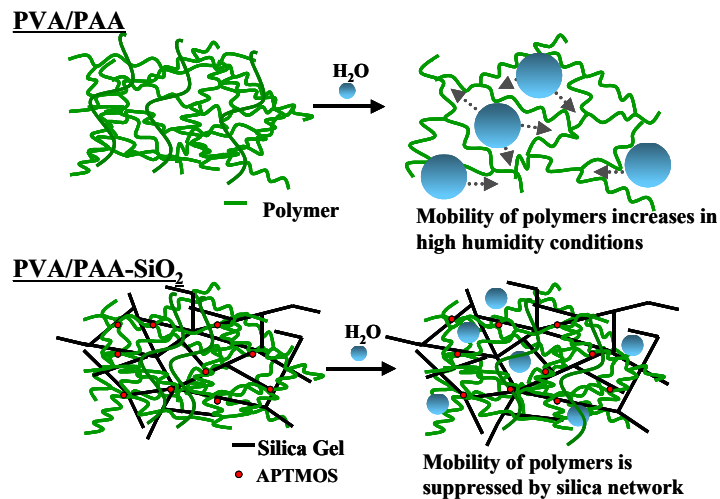


Figure 2. Cross-sectional TEM images of hybrid coatings



Scheme 1. Mechanism of high gas-barrier property induced by organic-inorganic IPN structure

Table 1. Properties of hybrid hard coating films (SiO₂ = 45 wt%)

	Gas Permeability			Abrasion Resistance		
	OTR (cc/m ² day atm)		WVTR (g/m ² day atm)	ΔHase	Pencil Hardness	
	50 %RH, 20 °C	90 %RH, 20 °C	90 %RH, 40 °C	PC	PC	Glass
Substrate ¹⁾	24	24	12.9	55	5B	-
PVA/PAA	<0.1	11	12.8	31	B	4H
PVA/PAA+SiO ₂ ²⁾	<0.1	1.8	12.8	6.7	HB	8H

1) PET48.5 μm for gas permeability test

2) APTMOS modified composite

Functional Polyethylene Wax for Polymer Processing

EXCEREX™

Kuniaki Kawabe

Functional Polymeric Materials Laboratory, Mitsui Chemicals, Inc.

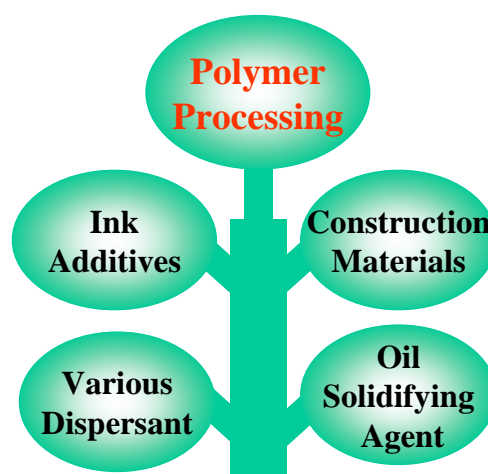
EXCEREX™ is a functional polyethylene wax commercialized for the first time in the world in 2004 by making good use of the metallocene catalyst.

We can give this functional polyethylene wax the various features that show high performance compared with the conventional polyethylene wax:

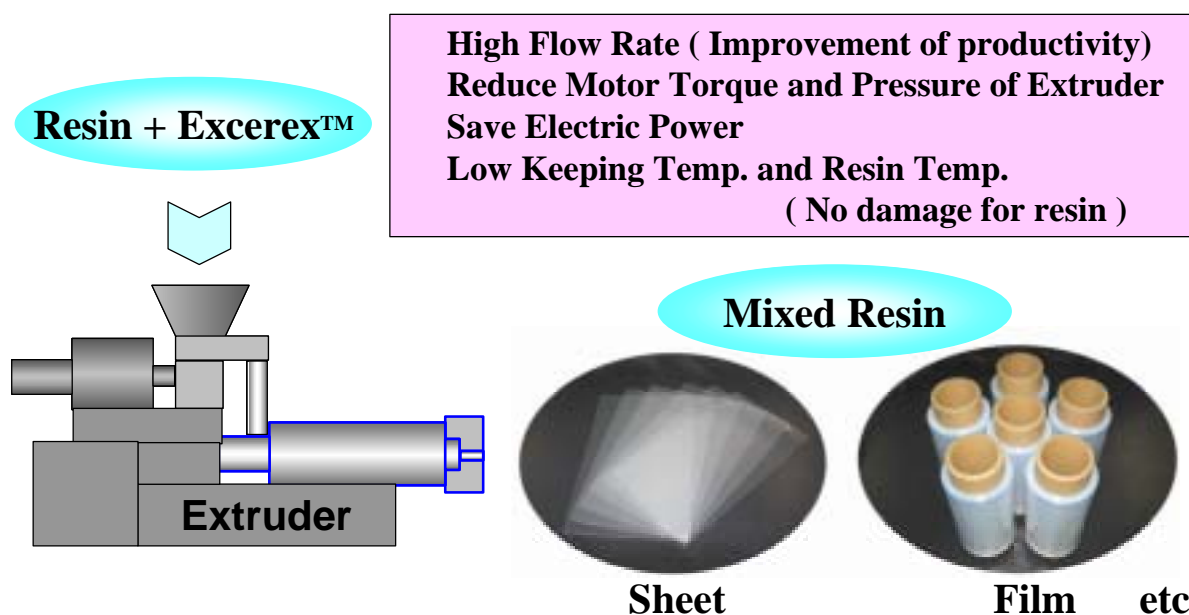
- Narrow composition distribution
- Narrow molecular weight distribution
< Good compatibility with other resins >
- Wide range of physical properties control
< Possibility of adjustment to new fields >

Many applications have been commercialized with the merits of these features and we have begun the development of EXCEREX™ for polymer processing.

Applications of EXCEREX™



Merits of EXCEREX™ for Polymer Processing



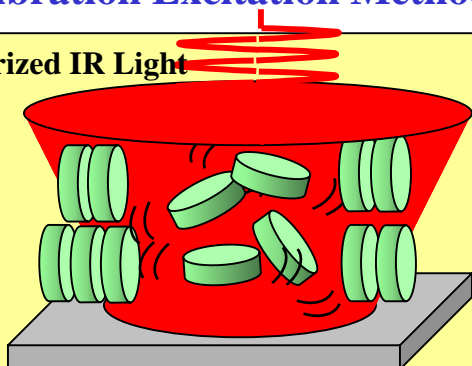
Orientation Control by Laser heating for Organic Semiconductor Material

Shiro Shichijyo, Kimihiko Saito and Kentaro Nakayama
Material Science Lab., Mitsui Chemicals Inc.

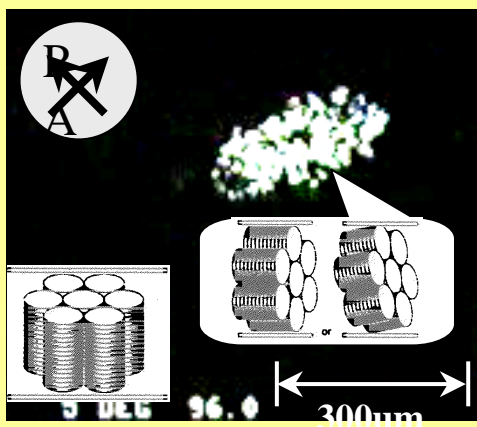
Abstract: Organic semiconductor thin film devices (EL, TFT, Solar Cell etc.) becomes prosperous in recent years and higher mobility is required to improve these device performance. To obtain higher mobility, molecular orientation alignment is important. Mitsui chemicals developed two methods for orientation control using laser light. Vibration Excitation Method: Orientation of discotic liquid crystal was demonstrated by exciting C=C stretching vibration mode using linearly polarized IR laser (free electron laser). Columnar direction was parallel to the polarization direction. Laser scanning Method: Melting and recrystallization process during laser scanning of visible laser succeeded to make crystals, in which molecular column axis oriented in the laser scanning direction. These methods are suitable for making high performance organic films.

Vibration Excitation Method

Polarized IR Light



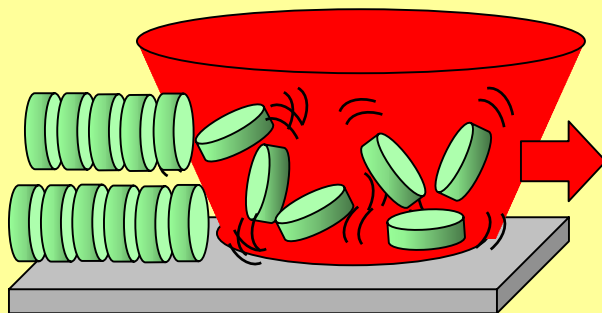
Linear polarization makes molecular orient in low absorption direction



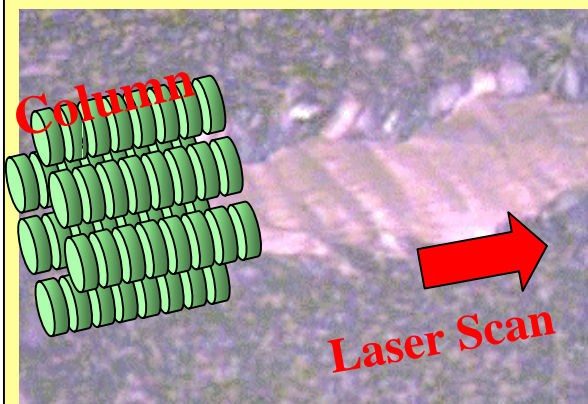
Effective in materials which have columnar mesophase.

Laser Scanning Method

Unpolarized Laser Light



Laser scanning makes molecular orient in scan direction



Effective in materials which have melting temperature and absorption in visible region.

New Value-Added Polyolefinic Materials Created by FI Catalysts

Motoaki Isokawa, Naoshi Nagai, Yasushi Nakayama, and Terunori Fujita

Catalysis Science Laboratory, Mitsui Chemicals, Inc.

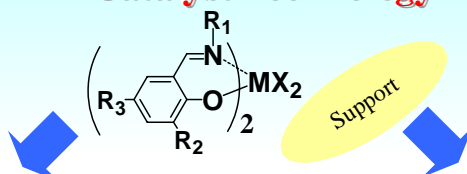
<Abstract>

Mitsui Chemicals' new and original catalysts for olefin polymerization, known as FI Catalysts, are capable of producing a variety of olefinic materials, which are unobtainable using conventional catalysts. For example, FI Catalysts combined with MAO can produce vinyl-terminated low molecular weight polyethylenes (named FI-Oligomers, vinyl selectivity > 95 mol%). Starting with the FI-Oligomers, a wide array of functionalized olefinic materials, block and graft copolymers can be developed, which possess numerous potential applications in many fields, for example, polymer additives, coating materials, healthcare materials, etc.

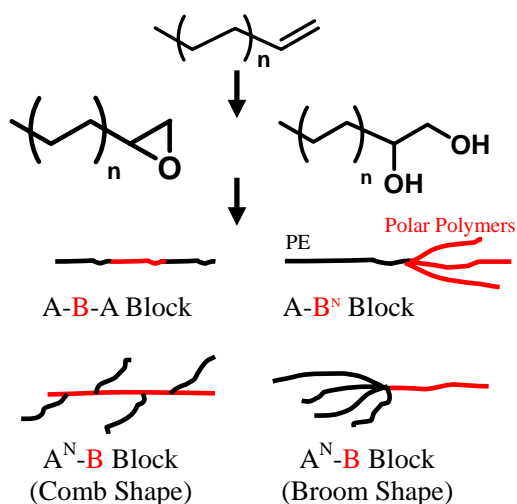
Alternatively, FI Catalysts with $MgCl_2$ ($MgCl_2$ -supported FI Catalysts) are capable of producing a variety of significant morphology polymers, which include ultra-fine non-coherent particle polyethylenes of 10 microns in size. In addition, chemical modification of these ultra-fine particle polyethylenes results in functionalized ultra-fine particle polyethylenes. These ultra-fine particle polyethylenes will expand the utility of polyethylene materials.

In the near future, Mitsui Chemicals will open up a market for brand-new polymeric materials based on FI Catalyst technology.

FI Catalyst Technology

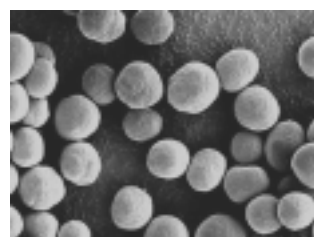


Vinyl-terminated Low Mw PE (FI-Oligomer)



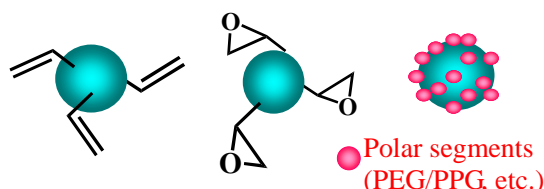
Macromonomers, Compatibilizers, Wetting-agents, Additives for cosmetics, Anti-static agents, etc.

Ultra-fine PE Particles (FI-Pearl)



- Spherical, Non-coherent

Surface modified FI-Pearls



Sintered filters, Light diffusion films, Cosmetics, etc.

Polymer Nanocomposite

*Wang Ke, Masaya Kotaki, Mya Khine Yi, Chen Ling, He Chaobin
Institute of Materials Research and Engineering*

In IMRE, R&D efforts have been focusing on understanding the structure-property relationships of polymer nanocomposites and exfoliating/dispersing nano-fillers in different polymer matrices to maximize their physical and mechanical properties via the “nano-effect”.

Polymer/clay nanocomposites

The exfoliation and dispersion of clay in polymer matrix is the key to maximizing performance. IMRE has developed novel approaches for the preparation of polymer/clay nanocomposites. Very small amount of organic modifier is required to facilitate the exfoliation and dispersion of clay. Both the Young's modulus and fracture toughness of the nanocomposite have increased significantly by incorporating clay with this new approach.

Carbon Nanofiber / Polymer Composites

IMRE has developed new epoxy/clay/electroconductive nanofiller composites by dispersing exfoliated clay layers into the epoxy/carbon nano-fiber systems to achieve high electrical conductivity with relatively small amount of electroconductive nanofiller. The new nanocomposites and the concept can be a highly potential candidate and approach for structural components in aerospace applications and many others where high conductivity and high mechanical properties are required at the same time.

Polymer/alumina nanocomposites

Transparency is one of the unique advantages of polymer nanocomposites. IMRE has developed transparent, high strength nanocomposites by dispersing nanoparticles into polymer matrices. Nanoscale alumina particles were uniformly dispersed into polymer matrix. Both the stiffness and toughness have been improved significantly, while the transparency is maintained. The material can be used for transparent & scratch-resistant coatings.

Polymer/POSS nanocomposites

Polymer nanocomposites containing POSS structure have been regarded as structural materials for the next generation, which is the key enabling technology for the development of nano devices such as NMES, nano-optics and nano-sensor. In IMRE, different POSS materials have been designed and synthesized. With the incorporation of POSS, the thermal stability, hardness and modulus of the nanocomposites increased significantly while the dielectric constant decreased obviously. The materials can be applied as high hardness coatings

Novel Design of Hyperbranched Polymers and Applications

Liu Ye

Institute of Materials Research and Engineering

Dendritic topology and abundant terminal groups render hyperbranched polymers distinctive properties and applications. However, new design of more cost-effective synthesis approaches and morphologies of hyperbranched polymers is desirable to meet the requirements of applications.

On the basis of fundamental understanding of the polymerization mechanisms, we have designed novel approaches to synthesize novel hyperbranched polymers via Michael addition polymerizations of multifunctional amines. The hyperbranched poly(amino ester)s could be prepared from commercially available monomers via convenient one-pot processes, and showed low cytotoxicity, good DNA condensation capability and good DNA transfection efficiency. Therefore, some of the poly(amino ester)s are promising for safe and efficient gene delivery. In addition, hyperbranched poly(amino ester)s could emit fluorescence. Furthermore, hyperbranched polymers were grafted to chitosan and the side wall of carbon nanotubes for bio-applications.

Abstract for SIS-2006

Three dimensional ligands (carboranes) in homogeneous catalysis

Zhu Yinghui, Shirley Lo Pei Sia

*Institute of Chemical and Engineering Sciences (ICES), 1, Pesek Road, Jurong Island
Singapore 627833*

Abstract

Three dimensional carboranes are electron-deficient boron cage systems in which one or more carbon atoms are present as an integral part of an electron-delocalized framework. The study of carborane has developed into a special area of inorganic-organometallic chemistry with potential applications in organic and polymer synthesis. All carboranes are extremely thermostable due to their substantial delocalization of valence electrons. The presence of carbon reaction sites provides an extensive set of derivatization chemistry. The study of carborane has developed into a special area of inorganic-organometallic chemistry with potential applications in organic and polymer synthesis. Preliminary results of carborane-derived catalysts in asymmetric hydrogenation and olefin polymerization reactions will be reported.

Functional Polymers-Synthesis and Applications

NSTA – Specialties and Polymer Chemistry Team

Anbanandam Parthiban, Han Hong, Ng Yeap Hung, Lily Yang Liqi, P.S. Suresh, Christina Chai

Abstract

Functional polymers play an important role in improving the performance of many products such as paints and coatings, paper, adhesives etc. Novel techniques are being adopted to tune the surface properties of the polymers while leaving the bulk properties unchanged. With significant advances in our understanding of cell-material interaction, new methods for tailoring properties of biodegradable materials are also constantly being explored. In ICES, we have synthesized oligomers and polymers having functionalities such as olefinic, epoxide, hydroxyl groups by various polymerisation processes. We have also synthesized block copolymers having hydrophilic and hydrophobic segments. In addition, we have developed chiral polymers and solid supports, for applications in the synthesis of commercially important optically active compounds and for use as chiral separation materials.

The Use of Raman Array Microscopy and Numerical Analysis for the Authentication of Commercial Objects

*Effendi Widjaja and Marc Garland**

Abstract

Due to widespread counterfeiting of various commercial objects, the need for non-destructive and accurate authentication is obvious. A wide range of analytical methods and instrumental techniques in screening and identifying the suspected counterfeits have been developed. Vibrational microspectroscopies, such as Raman and infrared, are favorable techniques, since these techniques are non-destructive and they provide a wealth of specific molecular level information on the materials or objects being analyzed. As such, identification of specific analytes leading to authentication is made possible. Raman array microscope in particular, which integrates spectroscopy with mapping and imaging technology, has the capability to generate hundreds or even thousands of Raman spectra from one specific area of sample with spatial resolution at around 1 μm . However, visual examination of all collected spectra in one area is certainly not practical and thus more sophisticated techniques for rapid, objective analysis, and good presentation of data is an absolute requirement. Multivariate statistical analysis can certainly play an important role since all collected spectral information is included in the numerical analysis. The collected spectral data are then processed by an advanced chemometric tool. A novel spectral deconvolution technique developed in Prof Garland's group (NUS and ICES) namely band-target entropy minimization (BTEM) is employed to un-mix the mixture spectra to determine the number of chemical components present and to extract the pure component spectra of the samples. With the identification of the chemical components present via BTEM, authentication is made possible. An example of a commercial object (40 cent Singapore stamp) being characterized using a Raman array microscope is presented. An area of $50 \times 50 \mu\text{m}^2$ of the stamp was imaged using the point mapping mode with a step size of 2.5 μm in both the x and y directions. Scans were collected using a static 1800 groove per mm dispersive grating resulting in a spectral window from 1052 to 1700 cm^{-1} . Acquisition time for each spectrum was 15 seconds. The final three-dimensional imaging data cube collected from this experiment is of the format 41 x 41 x 782. There were 1681 Raman spectra collected from this experiment. After some spectral pre-processing, such as smoothing and baseline correction, these mixture spectra were subjected to BTEM analysis. Three dyes were identified and their spatial distributions on the area being imaged were generated. The extension of this technique for stamp counterfeiting detection is certainly possible. After resolving the pure component spectra of dyes, the identities of dyes can be known, hence the authenticity of the stamps can be simply judged by the presence or absence of certain components.

DFT Calculations on Nanometal-Polymer Composites: The Case of Polyimide-Cu(100) / Ni(100) Adhesion

Michael B. Sullivan, Jia Zhang, Jian Wei Zheng, Kian Ping Loh and Ping Wu

Abstract

The interfacial properties of polyimide (PI) / M(100) (M = Cu and Ni) were investigated using density functional theory (DFT). A PMDA-ODA monomer unit was used to represent the full PI and the surface was represented by periodically repeated slabs. PI prefers the bridge and top sites on Cu(100) surface but only forms weak C=O-Cu interactions. PI favors the bridge site on Ni(100) surface and can form strong C-Ni, N-Ni and C=O-Ni bonds. The adsorption energies of PI on Cu(100) and Ni(100) surfaces are -0.58 eV and -4.7 eV, respectively. Compared to the adsorption energies of O and O₂ on Cu(100) surface, the adsorption of PI on Cu(100) is not energetically favorable, which leads to the easy oxidation of Cu particles in Cu/PI nanocomposite. The good adhesion at PI / Ni(100) suggests that Ni is a better candidate as a metal filler compared to Cu in the metal-polyimide composite.

Mesoporous Functional Materials of Highly Ordered Nanoarrays

*Yu Zhang and John Wang**

*Department of Materials Science and Engineering,
National University of Singapore, Singapore, 119260
E-mail: msewangj@nus.edu.sg*

Abstract

Highly ordered and crystallized mesoporous TiO₂ thin films have been successfully synthesized via a template route on selected substrates. They were characterized by using TEM, XRD, Raman, and UV-visible spectrophotometry. A transition of pore configuration from cubic to cage-like arrays, accompanied by an increase in crystallinity, was observed to take place when the substrate is changed from an amorphous glass slide, polycrystalline Pt substrate to single crystal Si wafer. On the basis of our systematic studies, the observed pore configuration transitions and titania phase evolutions can be accounted for by considering the free surface energy involved in each of the systems. Photocatalytic decomposition of methylene blue with these mesoporous titania films has also investigated. The highly crystallized films formed on Pt and Si substrates exhibit enhanced photocatalytic reactivity, as compared to the amorphous films formed on glass substrates.

Keywords: Mesoporous structure, Titania, Substrate, Photocatalysis

Functional Polymers for Applications in Environmental Analytical Chemistry

C. Basheer, V. Suresh & H.K. Lee
Department of Chemistry
National University of Singapore
3 Science Drive 3
Singapore 117543
Email: chmleehk@nus.edu.sg

Sample preparation is a critical step in any analytical chemistry procedure, and particularly so in environmental analytical chemistry where ‘dirty’ matrices can have a profound impact on final data quality. In highlighting the marriage of materials chemistry and analytical chemistry, we have designed and synthesized several functional polymers for use as analyte adsorbents in various modes of miniaturized sample preparation approaches for aqueous samples. These environmentally-friendly solvent-minimized and solventless extraction procedures include solid-phase microextraction (SPME) where analytes are directly adsorbed onto the functional polymers coated on fused silica fibres without need of organic solvent, or polymer-coated hollow fibre microextraction (PC-HFME), in which analytes are extracted by these adsorbents coated on polypropylene or polysulfone hollow fibre membranes that are then used as microextraction devices involving the use of mere microlitre volumes of organic solvent. In contrast, conventional sample preparation and extraction procedures use tens to hundreds of millilitres of organic solvent which ultimately generate a lot of waste. After extraction, the analytes are desorbed and determined by gas chromatography/mass spectrometry, liquid chromatography or capillary electrophoresis. This paper will describe the synthesis of several functional polymers that have various affinities for important aqueous environmental contaminants and pollutants, for use in SPME and PC-HFME devices.

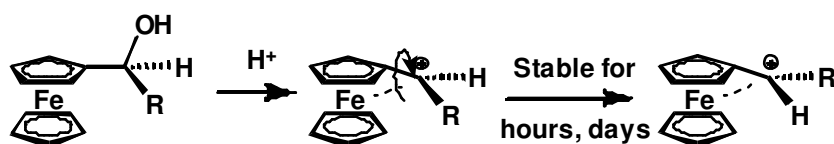
Asymmetric Synthesis of Amine Derivatives using Ferrocene-based Chiral Carbocation

*Ai-Hua Seow, Hin-Soon Cheng, Hao Li and Teck Peng Loh**

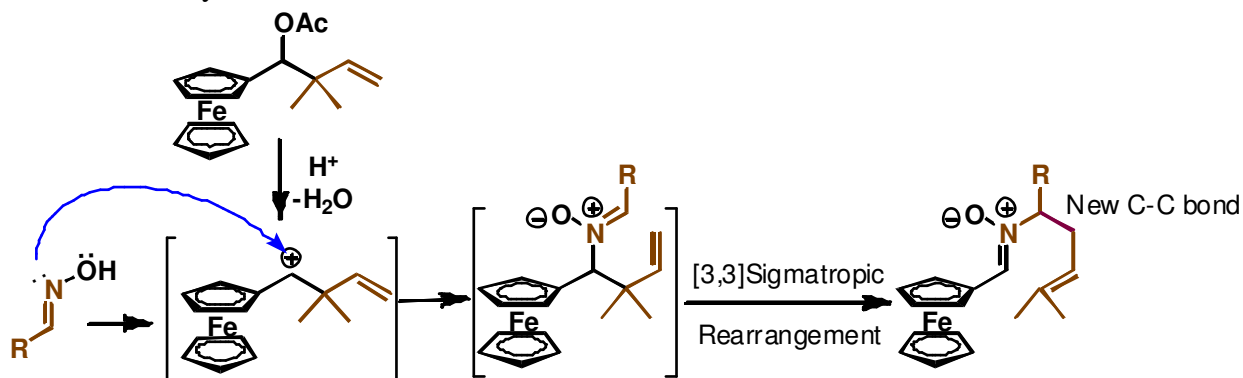
*Division of Chemistry and Biological Chemistry,
Nanyang Technological University, Singapore*

Abstract

Since made in 1951, ferrocene has been an important compound for many chemical transformations especially in catalysis and polymerization process. One of ferrocene's interesting features is its surprisingly capability of stabilizing carbocations that are adjacent to the cyclopentadienyl ring (α -ferrocenylalkyl carbocations). It has been shown that this carbocations is chiral¹ and hence is a potential Lewis acid catalyst for asymmetric organic transformations.²



Here in, we develop a new Mannich-type C-C bond formation methodology using ferrocenyl carbocation as key intermediate.



References

- 1) Togni, A.; Hayashi T. *Ferrocenes*, Weinheim: New York, 1995.
- 2) Taudien, S.; Riant, O.; Kagan, H. B. *Tet. Lett.* **1995**, *36*, 3513-3516.

Multi-layered Biodegradable Polymer Structure for Drug eluting Stents

*Freddy YC Boey, Subbu Venkatraman, Chia Ngeow Khing
School of Materials Science & Engineering,
Nanyang Technological University*

The biodegradable stents are useful in a variety of medical applications where a body lumen, hollow organ or other cavity is desired to be deconstricted or de-restricted. Thus, such a stent is useful *inter alia* in the treatment of blockages or potential blockages and/or the prevention of restenosis of vascular, urinary, biliary, tracheobronchial, oesophageal and renal tracts. In an embodiment, the helical shape of the stent facilitates the insertion of the stent and maintenance of the lumen in an open state. They can also be formed having multiple layers. The layers may be arranged sequentially, relative to the helical width, thereby forming an outer and one or more inner layers.

The multi-layered structure offers several advantages:

- self-expansion occurs at 37°C
- capability of delivering more than 1 drug at
- controlled release rates
- load much higher drug amounts than normal stents
- delivery time can be anywhere from 3 weeks to 1 year