

THREE PIONEERS OF CD RESEARCH: PART 1. PROF. TSUNEJI NAGAI

Cyclodextrin News starts a series on the scientists having a remarkable impact on the CD research and applications. The first editorial in this series is dedicated to Prof. Tsuneji Nagai celebrating his 80th birth day on June 10.



Prof. Tsuneji Nagai started his research on cyclodextrins in the seventies. His first CD-related paper was published on the interaction of α - and β -CD with several non-steroidal antiinflammatory drugs in 1975 [1].

The number of his CD-related publications is about 60. The main topics include: inclusion complex formation of NSAID drugs, barbital, cinnarizine, carmofur, nitroglycerine, epinephrine, nasal formulation of β -interferon with DIMEB, cyclodextrin polymers for drug delivery, stabilization of photosensitive drugs via complexation, solubilization of fullerenes, preparation and characterization of large cyclodextrins and branched cyclodextrins, etc. He discovered that the drug (cinnarizine) release from its complex with β CD can be enhanced by using a competitive guest (phenylalanine) [2]. His one of the latest publication on cyclodextrins in 2010 is on fullerene solubilization with large CDs [3].

Proceedings of the 9th International Cyclodextrin Symposium was dedicated to the 65th birthday of Tsuneji Nagai and Jozsef Szejtli.

Prof. Nagai's interest was not focused only on cyclodextrins. He was involved in the most up-to-date pharmaceutical developments. The latest research on magnetic targeting is just an example [4].

On the occasion when a fellowship of the Controlled Release Society was named after him, his laudation was as follows [5]: "Professor Nagai's work in bioavailability studies and controlled drug delivery formulations has contributed greatly to the pharmaceutical science of Japan, Asia, and the world. His distinguished career

includes leadership positions at Hoshi University, service on multiple boards including the Controlled Release Society presidency, direction for the Nagai Foundation Tokyo, and a body of work that includes three ethical drug products, more than sixty patents, and more than five hundred refereed published research papers, resulting in multiple prestigious awards. Beyond measure, Prof. Nagai has influenced students and colleagues whose work continues to significantly impact delivery science."

Tsuneji Nagai, is still the President and Honorary Professor of Hoshi University, Tokyo. He serves as a member of Scientific Advisory Board of several companies. He is world-wide recognized in advanced drug delivery fields. Prof. Nagai is the member of the respective advisory committee of the Ministry of Health and Welfare (MHW), Japan, the past President of Controlled Release Society, Vice President of FIP (International Pharmaceutical Federation), and the founder of The Nagai Foundation Tokyo. His name has been included in "Who's Who in the World" (1991), "The International Directory of Distinguished Leadership" (1992), and "Five Hundred Leaders of Influence" (1993). Prof. Nagai received numerous national and international awards. He has developed three marketed products: "*Aftach*"; "*Rhinocort*"; "*Salcort*".

The Nagai Foundation Tokyo (NFT) was founded on October 25, 1986 in commemoration of Prof. Tsuneji Nagai receiving the 1986 Hoest-Madsen Medal from FIP (International Pharmaceutical Federation) as the first for Japanese. The aim of NFT is promoting international exchange in pharmacy and pharmaceutical sciences. Several young fellows as well as professors also those involved in CD research were supported. NFT is a regular sponsor of the national and international CD symposia and conferences.

Happy birthday Prof. Nagai!



References

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2. Tokumura, T.; Tsushima, Y.; Kayano, M.; Machida, Y.; Nagai, T. (1985) Enhancement of bioavailability of cinnarizine from its β -cyclodextrin complex on oral administration with DL- phenylalanine as a competing agent. *J. Pharm. Sci.*, 74(4), 496-7
3. Furuishi, T., Endo, T., Nagase, H., Ueda, H., Nagai, T. (2010) ChemInform Abstract: Solubilization of C70 into Water by Complexation with δ -Cyclodextrin. Article first published online: 16. JUN. 2010, DOI: 10.1002/chin.199915127
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5. Controlled Release Society 2011 <http://www.controlledreleasesociety.org/about/foundation/Pages/2011TsunejiNagaiPostdoctoralFellowship.aspx>
6. The pictures are from: <http://www.controlledreleasesociety.org/about/foundation/Pages/2011TsunejiNagaiPostdoctoralFellowship.aspx>
<http://meeting.dxy.cn/article/6581>

New green technology for gold mining by using α CD

Prof. Stoddart's team has published in the *Nature* a new technology for gold recovery from gold-bearing raw materials using α CD [1]. Gold dissolved in the form of KAuCl or KAuBr is precipitated when α CD is added. Channels are formed, which are filled by alternating $[\text{K}(\text{OH}_2)_6]^+$ and $[\text{AuBr}_4]^-$ polyionic chains to generate a "cable-like superstructure". „This discovery heralds a green host-guest procedure for gold recovery from gold-bearing raw materials making use of α -cyclodextrin—an inexpensive and environmentally benign carbohydrate.”

The dangerous and expensive cyanide technology aims to dissolve gold from the ore. The gold recovery from this aqueous solution is performed by adsorption on activated carbon (and then elution or heating), or by electrolysis. The recovery step could be replaced by using a green self-assembling process and green raw materials (CD) according to the process reported.

1. Liu, Z., Frasconi, M., Lei, J., Brown, Z.J. Zhu, Z., Cao, D., Ieh, J., Liu, G., Fahrenbach, A.C., Botros, Y.Y., Farha, O.K., Hupp, J.T., MirkinC.A., Stoddart, J.F.: Selective isolation of gold facilitated by second-sphere coordination with α -cyclodextrin. *Nature Communications* 4, Article number: 1855 1038/ncomms2891. Published 14 May 2013



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1. CDs: Derivatives, Production, Enzymes, Toxicity

V. Crupi, A. Fontana, M. Giarola, D. Majolino, G. Mariotto, A. Mele, B. Rossi, F. Trotta, V. Venuti:

Cyclodextrin Nanosponges: a Thorough Investigation of Structural and Dynamic Properties By Vibrational Spectroscopy and Numerical Simulation Methods

Raman and infrared spectroscopy

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy O-07, 34

K. Martina, G. Cravotto, M. Caporaso, L. Rinaldi, C. Villalonga-barber and G. Ermondi:

Highly Efficient Synthesis and In Silico Chemical Screening of Per-substituted Cyclodextrins

reduction of per-(6-azido-6-deoxy)-beta-CD to per-(6-amino-6-deoxy)-beta-CD, catalytic hydrogenation

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy P-01, 45

Ahmad, A.L.; Jawad, Z.A.; Low, S.C.; Sharif Zein, S.H.:

The functionalization of beta-cyclodextrins on multi walled carbon nanotubes: Effects of the dispersant and non aqueous media

environmentally friendly dispersant, FT-IR, TG, DLS, XRP

Current Nanoscience, 2013, 9, 93-102

Bai, Y.; Fan, X.; Mu, C.; Yang, Z.; Wang, D.; Zhang, H.:

Cyclodextrin-based topological macromolecules

star-like star-like cyclodextrin polymers, hyperbranched cyclodextrin polymers, dendritic cyclodextrin polymers

Progress in Chemistry, 2013, 25, 363-369



2. CD complexes: Preparation, Properties in solution and in solid phase, Specific guest

S. V. Babenko, Y. P. Tsentalovich, A. I. Kruppa:

Investigation of 2,21-dipyridyl complex formation in steady and excited triplet states with beta-cyclodextrin

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W. Krawczynska, B. Kudawska:

The Use Ft-ir To The Determination of Diisononyl Phthalate (dinp)/cyclodextrins Inclusion Complexes

Diisononyl phthalate, plasticizer, precipitation method

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy P-03, 47

I. Occhiuto, E. Fazio, G. De Luca, M. Castriciano, R. F. Pasternack, L. Monsi Scolaro:

Kinetic Investigations On Disassembling Porphyrin J Aggregates Induced By Cyclodextrins

heptakis(2,3,6-tri-O-methyl)- α -cyclodextrin, meso-tetrakis(4-sulfonatophenyl) porphyrin

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy P-17, 61

G. Raffaini, F. Ganazzoli:

Dimeric Inclusion Complexes of Cyclodextrin with Fullerenes

C60, C70, Molecular simulation, Molecular Mechanics(MM), and Molecular Dynamics (MD) methods

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy O-12, 39

M. Valero, F. Castiglione, A. Mele, C. A. Dreiss:

Hugging Tight Or Breaking-up: Love and Hate Between Polymers, Cyclodextrins and Drugs

poly(ethylene oxide)-poly(propylene oxide)-poly(ethyleneoxide) (PEO-PPOPEO), DIMEB, TRIMEB, competitive interactions, HPBCD, HEBCD, polypseudorotaxane, fluorescence spectroscopy, small-angle neutron scattering (SANS), NMR

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V. Villari, A. Mazzaglia, R. Darcy, C. O'driscoll, N. Micali:

Amphiphilic Cyclodextrin Nanoaggregates and Their Complexes with {DNA}

DOSY, enantiodiscrimination by cyclodextrins

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy
O-06, 33

Barao, C.E.; Paiva-Martins, F.; Zanin, G.M.; De Moraes, F.F.:

Determination of the inclusion complex constant between oleuropein and cyclodextrins by complexation theory

olive leaf, competition of two guests, methylorange

Journal of Inclusion Phenomena and Macrocyclic Chemistry, 2013, 1-6

3. CDs in Drug Formulation

F. Aiello, L. Vanni, G. Uccello-barretta, F. Balzano, F. Nardelli, L. Jicsinszky:

Nmr Structural and Conformational Characterization of 6-monodeoxy-6-mono(n-(l)-tyrosinyl)-beta-cyclodextrin (cd-tyr-cooh)

transport and controlled release of drugs, 6-monodeoxy-6-mono(N-(L)-tyrosinyl)-beta-cyclodextrin, ROE effects, enantiomers of dipeptides

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy
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R. Anand, I. Manet, F. Manoli, S. Monti, M. Malanga, E. Fenyvesi, A. Aykac, a. Vargas-berenguel, S. Daoud, A. Maksimenko, R. Gref:

Cyclodextrin Polymers As Carriers For Anthracycline Drug Delivery

Doxorubicin, beta-CyD-epichlorohydrin crosslinked co-polymer, gamma-CyD-citric acid crosslinked copolymer, circular dichroism, UV-vis absorption, fluorescence

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy
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A. Barge, M. Caporaso, E. Gianolio, K. Martina, P. Tosco and G. Cravotto:

gamma 1 beta 8 -cyclodextrin Oligomer, a New Multi-carrier Platform

CD azidation, MW-assisted CuAAC reactions, Molecular dynamics simulations, paramagnetic metal complex

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy
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E. Bilensoy:

Amphiphilic Cyclodextrin Nanoparticles In Tumor Targeting

nanospheres, nanocapsules, nanosponges, polyplexes, micelles, Tumor targeting, vasculature in tumor site, folate receptors, tamoxifen, paclitaxel, docetaxel, camptothecin

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy KL-1, 20

C. Cannavá, R. Stancanelli, S. Tommasini, A. Mazzaglia, K.I. Larsen, N. Micali, C. A. Ventura:

Amphiphilic Cyclodextrin Nanoaggregates For Idebenone Delivery

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O. Catanzano, V. D'esposito, F. Di Nardo, I. D'angelo, F. Ungaro, A. Miro , P. Formisano, F. Quaglia:

Development and In Vitro Evaluation of a Novel Colloidal Silver- Alginate Dressings For Wound Healing

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R. Cavalli, C. Dianzani, R. Minelli, F. Caldera, R. Fantozzi, F. Trotta:

Cyclodextrin-based Nanosponges For Camptothecin Targeted Delivery To Prostate Cancer Cells: In Vitro and In Vivo Evaluation of Therapeutic Effect

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Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy P-08, 52

C. Conte, A. Scala, G. Siracusano, S. Patan  , N. Leone, M. T. Sciortino, F. Ungaro, F. Quaglia, A. Mazzaglia:

Biodegradable Nanoparticles Based On Amphiphilic Cyclodextrins For The Combined Photodynamic- and Chemo-therapy of Solid Tumors

(2-Oligo(ethyleneoxide)-6-hexadecylthio-)-beta-CD, docetaxel, zinc-phthalocyanine, SNOM (scanning near-field opticalmicroscopy), SNOL (scanning near-field optical luminescence), NMR, phosphorescence, time-dependent singlet oxygen generation

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy O-01, 28



A. Fraix, A. R. L. Gonçálves, V. Cardile, A. C. E. Graziano, T. A. Theodossiou, K. Yannakopoulou and S. Sortino:

A Multifunctional Bichromophoric Nanoaggregate For Simultaneous Imaging and Photodynamic Therapy of Melanoma Cells

Singlet oxygen, nitric oxide, multitarget therapeutic agents, porphyrin labeled beta-cyclodextrin

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy P-04, 48

D. Iannazzo, A. Scala, A. Mazzaglia, A. Pistone, S. Galvagno, M. Lanza, M. T. Sciortino, A. Piperno, G. Grassi:

Synthesis of Novel B-cd/ Mwcnts Nanohybrid Through 'click' Coupling and Its Application As Drug Delivery System

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N. Kandoth, V. Kirejev, A. Fraix, M. B. Ericson, R. Gref, S. Sortino:

Cyclodextrin-based Photocage For Nitric Oxide Release and Two-photon Fluorescence Reporting

anthracene, nitric oxide, cyclodextrin-based polymer

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy O-10, 37

B. Martel, A. Martin, H. Van Den Berghe, A. Perez-anes, L. Leclercq, J. Lyskawa, N. Tabary, S. Degoutin, F. Aubert-viard, D. Douroumis, F. Cazaux, M. Gargouri¹, Chai¹, N. Blanchemain¹:

Multilayered Coatings Applied To Medical Textiles and Vascular Stents For Controlled Drug Delivery

cross-linking reaction with citric acid, layer-by-layer, superimposition of cationic and anionic polymeric species, chitosan, vascular stent, polyester nonwoven textile, SEM, Tertiobutylbenzoic acid, Toluidine Blue

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L. Montenegro, A. Trapani, P. Fini, G. Trapani, G. Puglisi:

Idebenone-loaded Chitosan and Chitosan Derivatives Nanoparticles Containing Sulfobutyl Ether-beta-cyclodextrin For Topical Administration

antioxidant effect, treatment of skin disorders, glutathione, Franz-type diffusion cells, skin permeation, DSC

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G. Rassu, M. Nieddu, G. Boatto, P. Bosi, P. Trevisi, E. Soddu, M. Cossu, P. Giunchedi, E. Gavini:

A Pharmacokinetic Study On Thymol-beta-cyclodextrin Complex

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B. J. Ravoo:

Stimulus-responsive Soft Materials Based On Cyclodextrin Vesicles

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V. Rizzi, P. Fini, A. Agostiano, P. Cosma:

4-Thiothymidine/2-hp-beta-cd Inclusion Complex: Probe For Reactive Oxygen Species Produced By Photosensitizer Photodynamic Activity In Aqueous Solution

singlet oxygen, electron transfer, 4-thiothymidine2-HP-beta-CD, Rose Bengal, Chlorophyll a

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S. Sortino:

Light-triggered Cyclodextrin-based Nanoconstructs with Multiple Imaging and Therapeutic Modalities

Singlet oxygen, nitric oxide, nanocarriers, multiple phototherapeutic and imaging modality

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G. Spada, E. Gavini, M. Cossu, G. Rassu, A. Salis, E. Soddu, P. Giunchedi:

Hydroxypropyl-beta-cyclodextrin As Carrier For Topical Administration of Milk Thistle Extract

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Carmen Alvarez-Lorenzo; Barbara Blanco-Fernandez; Ana M. Puga; Angel Concheiro:

Crosslinked ionic polysaccharides for stimuli-sensitive drug delivery

review, changes in pH, ions nature and concentration, electric and magnetic field intensity, light wavelength, temperature, redox potential

Advanced Drug Delivery Reviews, 2013

Daniel Arcos; Maria Vallet-Regi:

Bioceramics for drug delivery

large bone defects, osteoporotic fractures, bone infections, bone tumours, molecular nanogates, stimuli-responsive systems, review

Acta Materialia, 2013, 61, 890-911

Basaran, Berrin; Bozkir, Asuman:

THERMOSENSITIVE AND pH INDUCED IN SITU OPHTHALMIC GELLING SYSTEM FOR CIPROFLOXACIN HYDROCHLORIDE: HYDROXYPROPYL-beta-CYCLODEXTRIN COMPLEX

ocular drug delivery, NMR, FTIR, antimicrobial efficacy, DSC

Acta Poloniae Pharmaceutica, 2012, 69, 1137-1147

4. CDs in Cell Biology

Hidetoshi Arima; Keiichi Motoyama; Taishi Higashi:

Sugar-appended polyamidoamine dendrimer conjugates with cyclodextrins as cell-specific non-viral vectors

gene carriers mannosylated, galactosylated, lactosylated alpha-CDEs, PEGylated Lac-alpha-CDEs, glucronylglucosyl-beta-cyclodextrin

Advanced Drug Delivery Reviews, 2013

Samad Amini-Bavil-Olyaei; Youn Jung Choi; Jun Han Lee; Mude Shi; I-Chueh Huang; Michael Farzan; Jae U. Jung:

The Antiviral Effector IFITM3 Disrupts Intracellular Cholesterol Homeostasis to Block Viral Entry

Vesicle-membrane-protein-associated protein A (VAPA), oxysterol-binding protein (OSBP), multivesicular bodies, late endosomes

Cell Host & Microbe, 2013, 13, 452-464



5. CDs in Food, Cosmetics and Agrochemicals

W. Gaino, M. Devecchi, V. Scariot, F. Caldera, F. Trotta:

Inclusion Complex of Cyclodextrin Nanosponges with Active Molecules Extracted From *Ailanthus Altissima*

phytotoxic exudate, secondary metabolites, ailanthone, quassinoid, herbicidal effects, insecticide activity

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V. Rizzi 1 , P. Cosma 1 , A. Agostiano 1 , F. Fanelli 3 , P. Fini:

A Novel Photosensitizing Chl A/ Chitosan/2-hp-beta- Cyclodextrin Biofilm For Safety Food Applications

reactive oxygen species, biodegradable polymeric photosensitizer, ellipsometry, AFM, XPS, DSC},

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME – Italy P-05 49

6. CDs for other Industrial Applications

T. T. Do, R. B. Nielsen, R. Holm, K. L. Larsen:

Absorption Ability and Selectivity of Channel Type alpha-, beta- and gamma-cyclodextrin Crystals

absorption of volatile compounds from gas phase, metastable channel type crystal, XRD, GC, UV-Vis spectroscopy, BTEX

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy P-16, 60

E. Fenyvesi, C. Hajdu, M. Molar, K. Gruiz:

Potential of Cyclodextrins In Risk Assessment and Monitoring of Organic Contaminants

selective preconcentration, non-exhaustive extraction, microbial bioavailability, biodegradability, passive samplers, toxicity assay, bioassay

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy KL-2, 21



D. Iannazzo, A. Scala, A. Mazzaglia, A. Pistone, S. Galvagno, M. Lanza, C. Riccucci, G. M. Ingo, A. Piperno, G. Grassi:

Synthesis of B-cyclodextrin / Multiwalled Carbon Nanotubes Nanohybrid

capture of the aromatic pollutant from wastewater, XPS, XRD, UV-Vis, SEM, FEGSEM, TGA, TEM

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy P-15, 59

K. L. Larsen:

Production and Characteristics of Cyclodextrin Crystal Forms

gas phase, crystal structure, channel-type crystals, full accessibility of the cyclodextrin cavities, absorbents

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy KL-6, 25

R. Peila, F. Trotta, A. Ferri, F. Caldera:

Preliminary Results On Cyclodextrin Nanosponges/dyes Inclusion Complexes

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M. R. Plutino, A. Mazzaglia, M. A. Castriciano, L. Monsi Scolaro:

Novel Organometallic Derivatives of Amphiphilic Cyclodextrins Bearing [1,1'-bis(diphenylphosphino) Ferrocene]platinum(ii)] Redox Tags

stimuli-responsive nanoplatfom, symmetrical heptaplatinated cyclodextrin, elemental analysis, NMR, UV/VIS absorption

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy P-18, 62

J. Potier, S. Manuel, S. Fourmentin, D. Fournier, P. Woisel, E. Monflier, F. Hapiot:

Multivalency In Aqueous Organometallic Catalysis: Contribution of Cyclodextrin-based Polymers

long alkyl-chain alkenes and CD-based polymers, hydroformylation of terminal alkenes

Abstract book of 4th National Conference CD.TE.C. 9-11 May 2013, Giardini Naxos ME Italy O-03, 30



Eric M. Adetutu; Renee J. Smith; John Weber; Sam Aleer; James G. Mitchell; Andrew S. Ball; Albert L. Juhasz:

A polyphasic approach for assessing the suitability of bioremediation for the treatment of hydrocarbon-impacted soil

non-exhaustive extraction methods, 1-propanol, HP-beta-CD, hydrocarbon bioaccessibility

Science of The Total Environment, 2013, 450-451, 51-58

Eric Adetutu; John Weber; Sam Aleer; Catherine E. Dandie; Arturo Aburto-Medina; Andrew S. Ball; Albert L. Juhasz:

Assessing impediments to hydrocarbon biodegradation in weathered contaminated soils

hydrocarbon bioaccessibility, HP-beta-CD extraction, bioavailability

Journal of Hazardous Materials, 2013

Jalal Arjomandi; Sara Eshghi:

In situ spectroelectrochemistry, electrosynthesis and growth rates of conducting polypyrrole and poly N-methylpyrrole on gold and indium tin oxide glass modified by thiolated alpha-cyclodextrin self-assembled monolayer's (SAMs)

thiolated alpha-cyclodextrin, self-assembled monolayers, UV-visible spectroscopy, conductivity, SEM, gold electrode, molecular templates

Journal of Electroanalytical Chemistry, 2013, 690, 38-46

M.A. Aroon; A.F. Ismail; T. Matsuura:

Beta-cyclodextrin functionalized MWCNT: A potential nano membrane material for mixed matrix gas separation membranes development

polyimide, immersion precipitation method, methane, carbon dioxide, permeances of membrane, DSC, TGA, TEM

Separation and Purification Technology, 2013

7. CDs in Sensing and Analysis

Ayat Allah Al-Massaedh; Ute Pyell:

Adamantyl-group containing mixed-mode acrylamide-based continuous beds for capillary electrochromatography. Part I: Study of a synthesis procedure including solubilization of N-adamantyl-acrylamide via complex formation with a water-soluble cyclodextrin

monolithic stationary phases, in situ free radical copolymerization of cyclodextrin-solubilized N-adamantyl acrylamide, piperazinediacrylamide, methacrylamide

Journal of Chromatography A, 2013, 1286, 183-191



C. Barba; R.M. Toledano; G. Santa-Maria; M. Herraiz; R.M. Martinez:

Enantiomeric analysis of limonene and carvone by direct introduction of aromatic plants into multidimensional gas chromatography

heptakis-(2,3,6-tri-O-methyl)-beta-cyclodextrin, stationary phase

Talanta, 2013, 106, 97-103

Gimena Acosta; Raul Silva; Raul A. Gil; Roxana Gomez; Liliana P. Fernandez:

On-line enantioseparation of chlorpheniramine using beta-cyclodextrin and carbon nanotubes after multivariate optimization

Multiwalled carbon nanotubes, solid phase extraction, racemate

Talanta, 2013, 105, 167-172

An, Songsong; He, Jiang; Sun, Lijuan; Ren, Dong; Ban, Yihe

Investigation of the inclusion behavior of HP-beta-cyclodextrin with polydatin in solution and its analytical application

molecular modeling, spectrofluorimetric method

Journal of Molecular Structure, 2013, 1037, 9-14

