Smart People with Smart Polymers from Organic Macromolecular Chemistry Group of Saarland University

The editorial of CDN pre-symposium issue was dedicated to the German scientists and cyclodextrin technologists.

This post-symposium issue of CDN is to thank Prof. Wenz, the Organizer and Chairman of the 17th International Cyclodextrin Symposium and his team for the excellent organization, for the high level scientific environment and for the kind hospitality. (Some of us thank Gerhard for the exhausting physical exercise during the first day’s excursion and for the unforgettable climbing on the last day at the industrial historic place at Völklinger Hütte together with culinary adventures.) Our host at the Saarbrücken Symposium, has been playing a world-wide recognized role in the chemistry, the synthesis of cyclodextrins and their derivatives, polymers, rotaxanes as well as their applications.

The successful symposium with more than 200 participants from all over the world has been a special and really stimulating event giving platform to the most sophisticated supramolecular structures useful for many applications from catalysis to pharmaceuticals, food and environmental field.

Speaking of the German Cyclodextrin scientists, Prof. Gerhard Wenz has a distinguished recognition, since he is today one of most decisive and influential chemists among German Cyclodextrin scientists.

Gerhard has been working in the field of CDs for over 25 years. In the beginning, he worked at the Max Planck Institute für Polymer Forschung in Mainz, on the synthesis and characterization of series of lipophilic CD derivatives. Per-O-pentylated CDs, like heptakis (2,6-O-dipentyl)-αCD, and (2,3,6-O-tripentyl)-αCD as well as the corresponding βCD analogues have been synthesized. He then collaborated with Prof. König (in Hamburg) by sending his per-pentylated CD derivatives for enantioselective gas chromatography. This fruitful co-operation of the organic chemist and the chromatographer, soon resulted in the design and commercialization of Lipodex® columns for enatioselective gas chromatography. The Macherey-Nagel company patented [1] these CD-enabled GC columns and now offers six different Lipodex GC capillary column products for enatioseparation.

Another patented discovery made by Prof. Wenz and colleagues is the synthesis and utilization of 2,6-di-O-butylated-3-O-acetylated CDs as catalysts for cyanoacrylate adhesives.[2] The
ethyl-2-cyanoacrylate which contains about 0.2 wt% of heptakis (2,6-di-O-butyl-3-O-acetyl)-βCD was used to bond SBR rubber with highly accelerated binding and shortened setting time (See Henkel’s Loctite glue products).

He wrote his first review on CDs as building blocks for supramolecular structures [3] and published his first results on the synthesis of cyclodextrin polyrotaxanes in Angewandte Chemie as early as in 1992 [4], the same year when the paper of Harada et al. on molecular necklaces appeared in the Nature [5].


The work in Karlsruhe was mainly devoted to cyclodextrin polyrotaxanes [6–9].

Furthermore the group synthesized the first self-organizing hydrogels by interaction of cyclodextrin polymers with guest polymers (Scheme 1) [10].

Scheme 1: Self-assembly of linear CD polymer and guest polymer with 4-tert-butylaniline moieties [9]

**Wenz at Saarbrücken**

In the year 2000, Prof. Wenz moved from Karlsruhe to Saarbrücken to University of Saarland, to become the head of Department of Organic Macromolecular Chemistry. Since then he has been conducting his research around smart polymers including also CD-based ones. The definition of these systems is given on the homepage of the group:

“**Smart Polymers** are functional materials with properties switchable by external stimuli like temperature, pH, time, light, pressure, magnetic fields, electricity, or specific receptor-ligand interaction. Smart Polymers are often inspired by biological systems and mimic living bones, tissues, cells, viruses and so on. We are interested in specific functions and material properties ranging from switchable mechanic and tribologic properties to molecular transport functions, for example for controlled drug delivery. We start from the natural
polysaccharides starch and cellulose because they are renewable feed-stocks independent from fossilic oil and gas. Furthermore, polysaccharides show a very high structural definition and they are generally non toxic, biocompatible, and biodegradable.” [11]

Among the about 100 CD-related publications (papers, conference proceedings and patents) of Prof. Wenz’s research team filed in the Cyclodextrin News database on 18.06.2014 we can find 39 hits for “polymer” as a keyword, 12 for “polyrotaxanes”, 10 for “supramolecular structures”, 5 for “immobilization”, etc. showing the main focus of the research. The 6 review papers on CDs as synthons [12], host-guest chemistry [13], molecular recognition [14] and on polyrotaxanes [15-17] are well cited.

The most recent results were demonstrated at the symposium. Some examples are as follows:

CD was conjugated to hyaluronic acid, a natural polymer of high biocompatibility and biodegradability. First mono-tosyl βCD was reacted with cysteamine hydrochloride to get amino functions and coupled to hyaluronic acid by 2-chloro-4,6-dimethoxy-1,3,5-triazine coupling agent (Scheme 2) [18].

![Scheme 2: Hyaluronic acid modified with CD](image)

Amphiphilic 6-thioalkyl CDs – useful carriers for delivery of camptothecin– were prepared and complexed with the fluorescence dye BODIPY to get a promising system to visualize transport processes into living cells [19].

A sophisticated gene delivery system was worked out by self assembly: cationic CD polyrotaxanes were prepared by threading first a heptacationic βCD and then αCD on highly water-soluble ionic polymers with long spacer groups. These cationic polyrotaxanes were especially useful for gene transfection even superior to polyethylene imine (PEI) (Scheme 3) [20].
Scheme 3: Nanoparticles formed of polyrotaxanes of polycationic polymer with polycationic CDs (βCDs in the middle of the chain and αCDs at the end) forming polyplexes with the double helix of genes [20]

A molecular toolkit based on CD-modified surfaces, ditopic guests and CD polymers with stiff backbones was developed and utilized to measure the adhesion and friction forces between two CD layers (the CD-modified silicone surface and CD-functionalized tip of the dynamic single molecule force microscope) in the presence and absence of ditopic adamantane guests (Scheme 34) [21].

Scheme 4: Self assembly via complex formation with a ditopic guest (adamantane) forming a non-covalent link between the CD-modified surface and a CD-modified polymer [21]

Prof. Wenz’s team has been regularly in the focus of scientific discussions at the International Cyclodextrin Symposia as shown by the 2 photos below.
Prof. Wenz with Dr. Buschman in 1996 in Budapest and with Dr. Szente in 2014 in Saarbrücken at the 8th and 17th International Cyclodextrin Symposia, respectively

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*CuAAC, Nonconventional Synthetic Methods, SWCNT, CD-Derivatized Silica*

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*Hybrid Cavitand-Cyclotrimeratrylene, Permethylated Cyclodextrin*

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**Synthesis and applications of cyclodextrin-based glycodendrimers**

*Chemoenzymatic Method*

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**CD/protein conjugates. synthesis and chemical and biological properties**

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Poster Presentation, No.: 1-01

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*Reaction of Dioleylphosphite on Permethylated 6-Monoamino-6-monodeoxy-β–cyclodextrin*

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**A cyclodextrin trimer as a triple hook for drug capture a highly efficient synthesis and characterization**

*Click Reaction, 6-Monodeoxy-6-N-monopargylamino-β–cyclodextrin*

Poster Presentation, No.: 1-04
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Poster Presentation, No.: 1-05

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**Allyl cyclodextrin derivatives for preparation of sorbents for tertiary treatment of wastewater**

*Heptakis(β-O-allyl-2,6-di-O-methyl)-β-cyclodextrin, Heptakis(6-O-allyl-2,3-di-O-methyl)-β-cyclodextrin, Partially Allylated β-Cyclodextrin, Partially Allylated RAMEB*

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**Systematic study on HPLC-MS properties of substituted cyclodextrins and their dependence on buffer type and concentration**

*BCD, HPBCD, SBEBCD, RAMEB*

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*CD-Based Nanotube, CDNT, Covalently Bound, Tail-to-tail Arrangement*

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**Towards the sequence-specific, multivalent molecular recognition of cyclodextrin oligomers**

*Small Peptides as Template, Synthesis of Cyclodextrin Sequences, Reversible Thiol-Disulfide Exchange, Thiolated α- and β-Cyclodextrin*

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**Inversion phenomenon on cyclodextrin dimers how avoided the tumbling?**

*Free 360 deg. Rotation, Tumbling*

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*Values of Critical Dilution*

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**Synthetic strategies for the fluorescent labelling of epichlorohydrin and citric acid cross-linked cd polymers**

*Rhodamin, Fluorescein, Nitrobenzofurazan, Coumarin*

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**Grafting of β-cyclodextrin dextran polymers to SiO2 surfaces: synthesis**

6-Monoazido-6-monodeoxy-β-cyclodextrin, CuAAC

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**Enabling technologies for selective CD functionalisation, synthesis of polymeric derivatives and CD-grafted materials**

Mechanochemistry, Microwave Assisted Synthesis, Ultrasound Activation, Flow Chemistry, [3-glycidoxypropyl]trimethoxysilane, Mesoporous Silica

Poster Presentation, No.: 3-06

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**Water-soluble methyl-β-cyclodextrin polymers: synthesis and fluorescent tagging**

*Epichlorohydrin, Citric Acid, Low DS Methylated β-Cyclodextrin, Hydrocortisone*

Poster Presentation, No.: 3-07

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

**Stabilization of channel type cyclodextrin crystals**

Noninclusion Complex Forming Additives, Glyceraldehyde, Xylose, Glucose, Vitamin C

Oral Presentation, No.: 4-F

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

**Production of channel type cyclodextrin crystals by forced precipitation in organic solvents**

*Channel and Cage Crystalline Structure, Organic Solvent, Precipitation, Powder XRD*

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**Tutorial about regioselective synthesis of CD derivatives**

*Mono-O-alkyl CD derivatives, Monitor Progress of Multiple or Per-6-substitution*

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

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**Synthesis and characterization of new bipyridyl-α-cyclodextrin coilands**

*Complexation Properties of Transition Metals*

Poster Presentation, No.: 1-08

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**The interplay of theory and experience for the development of cyclodextrins chemistry in supercritical CO₂**

*Self-closure ODF the Cyclodextrin Cavity*

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*Bis-Cyclodextrinyl-diazacrown-[2]cryptorotaxanes*

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**Stimuli-responsive self-assembly of soft nanomaterials based on cyclodextrin vesicles**

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Polymer, Nanotube Modified $\beta$–CD, PEI-Oligomer Grafted Adamantane
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Pyrene, Fluorescence, Heptakis(6-O-tert-butyldimethylsilyl)$\beta$–CD, Heptakis(6-O-triisopropylsilyl)$\beta$–CD
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*Viscoelastic Relaxation, Rubbery State, Strain Hardening Behavior*

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**Modification of physical property of poly(L-lactic acid) by cyclodextrins**

*TRIMEB, Fracture Strain*

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**Extended metal-carbohydrate frameworks**

*Cyclodextrin/Metalorganic Framework*

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**Preparation and properties of new cyclodextrin organogels**

*Hexagonal Nanostructures, sec-Butanol, SEM Image*

Poster Presentation, No.: 4-21

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**Nano insertion of cyclodextrins at biological membrane interfaces**

*Liposome Functionalization*

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**A molecular toolkit based on cyclodextrin polymers for surface materials with switchable tribological functions**

*Dynamic Single Molecule Force Spectroscopy, Friction Force Measurement*

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**Multistimuli switchable polypseudorotaxane mediated by cyclodextrin and cucurbituril**

*α-Cyclodextrin, Azobenzene, Cucurbit[8]uryl, Charge Transfer, Naphthyl Group*

Poster Presentation, No.: 5-02

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**Self-healing properties of supramolecular hydrogels formed by cyclodextrins and hydrophobic guest groups**

*Ferrocene, Redox Stimuli, CD-Adamantane Gel*

Poster Presentation, No.: 5-04
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**Redox-responsive supramolecular polymeric actuator based on host-guest interactions**

*Water-soluble Polymer Cross-linked with, Inclusion Complex, β--Cyclodextrin, Ferrocene, Artificial Muscle*

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**A molecular toolkit based on cyclodextrin polymers for surface materials with switchable tribological functions**

*Friction, Adhesion, Azobenzene, Atomic Force Microscopy*

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**3. CDs in Drug Formulation**

Gooding, M. J.; Darcy, R.; O’Driscoll, C. M.

**Synthesis of a flexible cyclodextrin toolkit for next-generation drug delivery**

*Coppercatalyzed Click Chemistry, PEGchains, Targeting polypeptides, polycations, siRNA*

Oral Presentation, No.: 1-B

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*Artificial Enzymes*

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**Solubility enhancement of nabilone by β-cyclodextrin and dimethyl-β-cyclodextrin inclusion complexation**

*Kneading, Supression of Oxygen Diffusion*

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**Conjugation of β-cyclodextrin to hyaluronic acid for controlled drug delivery**

*2-Chloro-4,6-dimethoxy-1,3,5-triazine, CDMT, Biodegradable Polymeric Backbone*

Poster Presentation, No.: 2-04

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**Preparation of econazole-cyclodextrin complexes using a single-step, organic-solvent-free supercritical fluid process.**

*RAMBE, HPBCD*

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**Complexation of benzoic acid and hippuric acid with β-cyclodextrin. experimental and theoretical studies**

*Ternary Complex, Benzoic Acid/β-CD/Glycine*

Poster Presentation, No.: 2-18

Belica, S.; Stepniak, A.; Palecz, B.

**Calorimetrical examinations of interactions between cyclodextrins and included copmaunds**

*Sertraline Hydrochloride, Tebuconazole, MCPA, Water, Water/Ethanol Solution,*

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Olteanu, A. A.; Arama, C-C.; Monciu, C. M.

**Investigation of cyclodextrin based nanospheres complexes with angiotensin converting enzyme inhibitors (enalapril, captopril, cilazapril)**

*Sulfobutylated β-Cyclodextrin, (2-Hydroxy)propylated-β-cyclodextrin, Nanosponge*

Poster Presentation, No.: 3-09

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**Dexamethasone-loaded γ-cyclodextrin-dextran microspheres for bone regeneration**

*Photoisomerization, Biomimetic Superhydrophobic Surface, Cytocompatibility, Acrylamidomethyl-γ-cyclodextrin*

Poster Presentation, No.: 3-11

Giglio, V.; Natile, G.; Intini, F.; Viale, M.; Aiello, C.; Vecchio, G.

**β-Cyclodextrin polymers functionalized with folic acid as new delivery systems**

*Water Soluble Amino-β-cyclodextrin Polymer, Antitumor Treatment*

Poster Presentation, No.: 3-12

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**Cyclodextrin-based supramolecular assembly as a platform for drug delivery**

*Targeting Delivery, Anticancer Drugs*

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**Construction of cyclodextrin/gold supramolecular nanocluster and its targeted delivery of anticancer drug**

*Gold Nanoparticles Bearing Adamantane Moieties, Biotin Modification*

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**pHEMA/Cyclodextrins hydrogels for controlled release of triamcinolone acetonide**

*Soft Contact Lens of Poly(hydroxyethyl-methacrylate)*

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Amphiphilic β-CD Derivatives with Decanoyl Alkyl Chains, Polysorbate 80
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Anticancer Drug, PLGA, Nanospheres
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Highly dispersible CEO nanoparticles by sugammadex under physiological conditions

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Cyclodextrins functionalized with nitroxyl persistent radicals: synthesis, magnetic behaviour and applications

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Peroxidase-encapsulated cyclodextrin nanosponge immunoconjugates as signal enhancement tool in biosensors

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Preparation and characterisation of cyclodextrin cross-linked poly(aspartic-acid) gels

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Dual cyclodextrin polymers based layer-by-layer coating

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In vitro and in vivo evaluation of cyclodextrin modified medical devices

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Versatile strategies for cyclodextrin bimodal systems with good aqueous solubility and efficient cell internalization for PDT

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Potential use of folate-appended methyl-β-cyclodextrin as a novel anticancer agent

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Release of β-galactosidase from poloxamine/α-cd hydrogels

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Quantitative determination of hydroxypropyl betadex in cerebrospinal fluid of children with Niemann-Pick Type C disease after intrathecal and intracerebral administration

Human Study, HPLC Method

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Cyclodextrin-poloxamer 407 polimeric micelles for drug delivery

Econazole, Itraconazole, Cysteamine, Thioglycolic Acid, Hydrosolubilization

Poster Presentation, No.: 6-05

Hydroxyapatite containing cyclodextrin microparticles for ciprofloxacin release

β-Cyclodextrin, RAMEB, (2-Hydroxy)propyl-β-cyclodextrin

Poster Presentation, No.: 6-06
Ferreiro, A. F.; Barciela, N. F.; Alvarez, A. L.; Mendez, J. B.; Barcia, M. G.; Otero-Espinar, F.J.

**Cyclodextrin-polysaccharide based in situ gelling system for ocular antifungal delivery**

*Bioadhesive Behavior, Cytotoxicity*

Poster Presentation, No.: 6-07

Oliveri, V.; Attanasio, F.; Puglisi, A.; Spencer, J.; Vecchio, G.

**Multifunctional 8-hydroxyquinoline-appended cyclodextrins as new inhibitors of metal-induced protein aggregation**

*Alzheimer's Disease, Parkinson Disease, NPC Disease, Metal Chelating Agent, Cu^{2+}, Zn^{2+}*

Poster Presentation, No.: 6-08


**Cyclodextrin-immobilized microspheres for uptake of N-acylhomoserine lactone as the quorum sensing signal**

*CD-Immobilized Alginate, Inhibitory Effect*

Poster Presentation, No.: 6-09


**Cyclodextrin finished facepiece respirator against pandemic threat**

*Air Filtration, Citric Acid, Cytocompatibility, Biocide*

Poster Presentation, No.: 6-10


**Control of bacterial intercellular communication due to the interaction between cyclodextrins and signaling molecules**

*Opportunistic Human Pathogens, N-Acylhomoserine*

Poster Presentation, No.: 6-12

Rajnavolgyi, E.; Laczik, R.; Kun, V.; Fenyesi, E.

**Effects of RAMEA-complexed polyunsaturated fatty acids on the response of human dendritic cells to inflammatory signals**

*Eicosapentaenic Acid, α-Linoleic Acid, Docosahexaenic Acid, Cell Surfsace Marker, Pro and Antiinflammatory Cytokines*

Poster Presentation, No.: 6-17

Simoes, S. M. N.; Figueiras, A. R.; Veiga, F.; Alvarez-Lorenzo, C.; Concheiro, A.

**Supramolecular α-cyclodextrin/PEO-copolymers for osteomyelitis and bone regeneration**

*Depots for Controlled Release of Antimicrobial Drugs, Vancomycin, Osteogenic Agents, Simvastatin*

Poster Presentation, No.: 6-18
Aubert-Viard, F.; Martin, A.; Chai, F.; Tabary, N.; Rahmouni, O.; Junthip, J.; Neut, C.; Martel B.; Blanchemain, N.

**Multilayer coating of a nonwoven polyester textile for antibacterial wound dressing**

*Multilayer Systems, Chlorhexidine*

Poster Presentation, No.: 6-19

Miao, Y.; Leteve, M.; Wattraint, O.; Sarazin, C.; Djedaini-Pilard, F.; Bonnet, V.

**Amphiphilic β-cyclodextrins: potential nanovecteurs of atanazavir**

*Blood-Brain Barrier, Glycerolipidyl-Cyclodextrins*

Poster Presentation, No.: 6-20


**Pharmacokinetic study of intravenously administered artemisinin loaded surface-decorated amphiphilic γ-cyclodextrin nanoparticles.**

*Co-nanoprecipitation of Bioesterified γ-Cyclodextrin, C10-Alkyl Chains, PEG Derivatives, DMPE-mPEG2000, Polysorbate 80, Antimalarial Activity*

Poster Presentation, No.: 6-21

Puskas, I.; Czifra, T. C.; Fenyvesi, E.; Szente, L.

**Self-assembly of cyclodextrin solubilized cholesterol in simulated human cerebrospinal fluid**

*Glucose Urea, Inorganic Salts, Aggregation Site*

Poster Presentation, No.: 6-23

Vyas, Amber

**Formulation and evaluation of topical gel containing nanolipid carriers loaded with cyclodextrin complexed anticancer drug for treatment of skin cancer**

*Polymerized Cyclodextrin, 5-FU, Complexation, Nanolipid Carriers*

Poster Presentation, No.: 6-22


**Quorum quenching using modified cyclodextrins**

*N-Acylhomoserine, Alkylamino-Cyclodextrins*

Poster Presentation, No.: 6-24

Shende, P.; Kulkarni, Y.; Gaud, R. S.; Deshmukh, K.; Cavalli, R.; Caldera, F.; Trotta, F.

**Acute and repeated dose toxicity studies on different nanosponges**

*Female Rat, Maximal Tolerated Dose*

Poster Presentation, No.: 6-25

Seo, J-H.; Kakinoki, S.; Yamaoka, T.; Yui, N.

**Modulating adhesion behavior of cells by changing the number of threaded α-cyclodextrin on polyrotaxane-coated surface**

*Polymer Surface, Cytoskeletal Signaling Pathway*

Poster Presentation, No.: 6-26
Conte, C.; Costabile, G.; Tirino, P.; D’Angelo, I.; Grassia, G.; Ialenti, A.; Ungaro, F.; Quaglia, F.

**Skin permeation of small pegylated nanoparticles aided by 2-hydroxypropyl-β-cyclodextrin**

Zn$^{2+}$-Phthalocyanine, Diblock Copolymer of PEG/Poly(epsilon-caprolactone), Permeation Enhancer

Poster Presentation, No.: 6-27

Conte, C.; Fotticchia, I.; Tirino, P.; D’Angelo, I.; Giancola, C.; Gref, R.; Ungaro, F.; Quaglia, F.

**PEGylated nanoparticles formulated with cyclodextrins: A novel role of cyclodextrins in nanotechnology field?**

Poly(epsilon-caprolactone)-Polyethylene glycol, PCL-PEG

Poster Presentation, No.: 6-28

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**4. CDs in Cell Biology**

Khuntawee, W.; Wong-ekkabut, J.; Hannongbua, S.; Wolschann, P.; Rungrotmongko, T.

**How does β-cyclodextrin penetrate into biological membrane?**

All-atom-MD simulation, Molecular Dynamics, H-Bond Interaction

Poster Presentation, No.: 2-15

Lopez, C. A.; Marrink, S. J.

**Computational microscopy of cyclodextrin mediated cholesterol extraction from lipid model membranes**

Free-Energy Calculation, Cyclodextrin Dimer

Poster Presentation, No.: 2-19

Roux, R.; Eskandani, Z.; Badi, N.; Bennevault-Celton, V.; Legrand, F.-X.; Huin, C.; Guegan, P.

**Star polymers based on β-cyclodextrins correlation between architecture and ability to form nanopores**

β-Cyclodextrin, Poly(ethylene oxide) Polymer, Lipid Bilayer

Poster Presentation, No.: 3-10


**Interaction of methyl-β-cyclodextrin with vesicles: about the destabilization mechanism and the role of cholesterol**

Phospholipid Bilayer Solubilization

Poster Presentation, No.: 4-04

Sortino, S.

**Photoresponsive cyclodextrin-based nanoconstructs with a multifunctional cargo**

Optical Syringe, Imaging Guided Phototherapy, Nanoparticle, Gel
Oral Presentation, No.: 6-A


**Development of 2-hydroxypropyl-β-cyclodextrin: Pluronic®-based polyrotaxanes as potential Niemann-Pick Type C therapeutics**

*Nonaqueous Conditions, Diethyl Ether, nHexane, Multivalent Magnetic Resonance Imaging Construct, Biodegradable Blood Pool Contrast Agent, Longcicrculating (2Hydroxy)propylbetacyclodextrin*

Oral Presentation, No.: 6-E

Yui, N.

**Significance of supramolecular frames of CD-based polyrotaxanes as biomaterials: extracellular and intracellular approaches**

*Endocytosis Pathway, Release of CDs, Intracellular Stimuli*

Oral Presentation, No.: 6-F

Bauer, M.; Charitat, T.; Daillant, J.; Fajolles, C.; Kekicheff, P.; Marques, C.

**From sliding anchored polymers to sliding tethered ligand interactions**

*Lipidbeased Nano Devices, Membrane Insertion*

Oral Presentation, No.: 6-G

Tamura, A.; Yui, N.

**Lysosomal cyclodextrin release from biocleavable polyrotaxanes directed toward ameliorating lysosomal storage disorders**

*Pluronic Chain, PEG-b-PPG-b-PEG, Intracellular Cleavage of Terminal Disulfide Linkage*

Oral Presentation, No.: 6-H

Zhang, Y-H.; Chen, Y.; Liu, Y.

**Cationic supramolecular nanoparticles for gene delivery**

*L-Cystine-bridged Bis(β-cyclodextrin)s, Adamantane Modified PEI, Transfection Efficiency*

Poster Presentation, No.: 6-01

Wenz, G.; Albuzat, T.; Keif, M., Wichter, J.; Dandekar, P.; Jain, R.; Lehr, C-M.

**Cellular delivery of polynucleotides by cationic cyclodextrin polyrotaxanes**

*Poly(bola amphiphile), Gene Transfection*

Poster Presentation, No.: 6-02


**Effects of cyclodextrin derivatives on GM1 ganglioside in fibroblasts differentiated from IPS cells derived from GM1 gangliosidosis patients**

*GM1 Ganglioside, Methylated Cyclodextrins, (2-Hydroxy)propylated Cyclodextrins, Branched Cyclodextrins*

Poster Presentation, No.: 6-11

**Potential use of cyclodextrin polypseudorotaxanes as sustained release drug carriers for low molecular weight drugs, protein drugs and gene drugs**

*PEGylated Liposome, Doxorubicin, PEGylated Insulin, γ-Cyclodextrin, Luciferase Gene Expression, Transfection Efficiency*

Poster Presentation, No.: 6-14

Hayashi, Y.; Higashi, T.; Motoyama, K.; Jono, H.; Ando, Y.; Arima, H.

**Potential use of peg-appended lactosylated dendrimer/cyclodextrin conjugate as a hepatocyte-selective sirna carrier for the treatment of familial amyloidotic polyneuropathy**

*Transthyretin, Cellular Uptake*

Poster Presentation, No.: 6-15

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**5. CDs in Food, Cosmetics and Agrochemicals**

Kfoury, M.; Auezova, L.; Greige, H.; Fourmentin, S.

**Effect of cyclodextrins on solubility, stability, controlled release and DPPH* scavenging activity of phenylpropanoids**

*Plant Secondary Metabolites, transAnethole, Estragole, Eugenol, isoEugenol, Caffeic Acid, pCoumaric Acid, Freulic Acid*

Oral Presentation, No.: 2-B

Sangpheak, W.; Khuntawee, W.; Wolschanrf, P.; Pongsawasdi, P.; Rungrotmongkol, T.

**Theoretical and experimental studies of hesperetin and naringenin by complexation with β-cyclodextrin and its dimethyl derivative**

*Flavanones Found in Citrus Fruits*

Poster Presentation, No.: 2-07


**Formation of ubiquinonoi by ubiquinone/γ-cyclodextrin inclusion complex with vitamin C**

*CoQ10, Lecithin, Micelle Formation FeSSIF, γ-CD Supplement*

Poster Presentation, No.: 4-02

Reuscher, H.

**New tasty foods by emulsification and whipping with α cyclodextrin**

*Thickering Agent, Soluble dietary Fiber, Egg Replacer*

Oral Presentation, No.: 6-D


**A study on inhibitory mechanism of lipid absorption by α-cyclodextrin administration**

*Lecitin, Bile Salts, Precipitation, α-cyclodextrin/Lecitin Complex*

Poster Presentation, No.: 6-16
6. CDs for other Industrial Applications

Kubik, S.; Bierwisch, A.; Koller, M.; Leidner, A.; Reiter, G.; Schneider, C.; Worek, F.
Evaluation of cyclodextrin derivatives as scavengers for the detoxification of chemical warfare agents
Organophosphonate, Cyclosarin, Structure-Activity Relationship
Oral Presentation, No.: 1-G

Jouffroy, M.; Semeril, D.; Armspach, D.; Matt, D.
Confining phosphines derived from cyclodextrins for efficient regio- and enantioselective hydroformylation
Rhodium Monophosphine
Oral Presentation, No.: 1-H
Garg, V.; Gupta, U.
β-Cyclodextrin butanediol diglycidyl ether polymer as solid phase extraction adsorbent for dichlorovos
Organophosphorous Pesticide
Poster Presentation, No.: 2-33

Takashima, Y.; Harada, A.
Supramolecular polymerization catalyst by cyclodextrin derivatives in water
Cyclodextrin Dimers, Polymerases, Permethylated Cyclodextrins with Phosphine Ligand, Supramolecular Polymerization Catalysis
Oral Presentation, No.: 3-B

Khaoulani, S.; Cazier, F.; Bychkov, E.; Fourmentin, S.
Remediation of real wastewater by cyclodextrin polymers
Adsorption, Hexamethylene Diisocyanate, Toluene-2,6-diisocyanate, Carbonyl Diimidazole
Poster Presentation, No.: 3-04

Potier, J.; Menuel, S.; Woisel, P.; Hapiot, F.; Monflier, E.
Pickering emulsions from CD-based hydrogels and CD-substituted polymers: application to aqueous organometallic catalysis
Rhodium Catalyzed Hydroformylation, Higher Olefine
Oral Presentation, No.: 4-D

Feng, S.; Yang, Z.; Zhang, X.
Enhanced adsorption of pollutants onto nano-particles through the formation of host-guest supromolecule
Protocatechuic Acid Functionalized β-Cyclodextrin, Bisphenol A
Poster Presentation, No.: 4-06

Assembly of cyclodextrin-functionalized particles at interfaces
Pickering Emulsion, Photoresponsive Chains
Silva, N. R.; Yutronic, N. I.; Jara, P. S.

**Crystals cyclodextrin inclusion compounds for growth of bimetallics nanoparticles**  
*Cu/Au Nanoparticles*

Poster Presentation, No.: 4-10

Kondo, Y.; Ulzii, M.; Tsurubuchi, K.; Yamada, M.; Hamada, F.

**Cesium extraction capability for hybrid polymers consist of β-cyclodextrin and diatomite**  
*Epichlorohydrin, Diatomite, Artificial Amorphous Silica*

Poster Presentation, No.: 4-24

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

**Absorption of volatile organic compounds by channel type cyclodextrin crystals**  
*BTEX, Hexane, Limonene, Channel Type CD Crystal*

Poster Presentation, No.: 4-25

Hamada, F.; Takagi, S.; Terui, A.; Rondo, Y.

**Gas adsorption profile based on hybrid polymers consist of modified cyclodextrins and amorphous silica**  
*Ethylenediamine Modified β-CD, Butyl β-CD Polymer, Hydrogen Adsorption*

Poster Presentation, No.: 4-29

Stade, L. W.; Duroux, L.; Nielsen, T. T.; Gurevich, L.; Larsen, K. L.

**Grafting of β-cyclodextrin dextran polymers to SiO₂ surfaces: surface characterization**  
*6-Monoamino-6-monodeoxy-β-CD, 1-Adamantanecarboxylic Acid, Antifouling Properties*

Poster Presentation, No.: 4-30

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**7. CDs in Sensing and Analysis**

Benkovics, G.; Malanga, M.; Jindrich, J.

**Supramolecular aggregates based on cinnamyl and hydrocinnamyl modified α- and β-cyclodextrins**  
*Capillary Separation Techniques, Regioisomers of Monocinnamyl-α- and -β-CDs*

Poster Presentation, No.: 1-11

Benkovics, G.; Rezanka, M.; Bednarova, E.; Blahova, M.; Jindrich, J.

**Synthesis and properties of regioisomers of monosubstituted cyclodextrin derivatives**  
*Allyl-, Cinnamyl- or Propargyl Bromide, Peracetates, Capillary Electrophoresis*

Poster Presentation, No.: 1-15
Sohajda, T.; Szente, L.

**Exploration of association forming affinity of cyclodextrins with capillary electrophoresis: pros and cons in a comparative view**

*Cyclodextrin Driven Interactions, Comparative Evaluation*

Oral Presentation, No.: 2-F


**Encapsulation of retinyl palmitate with a mixture of cyclodextrins and maltodextrins by the kneading method**

*Substituted Maltooligosaccharide, Capillary Electrophoresis*

Poster Presentation, No.: 2-02


**Development of ditopic type probe/cyclodextrin complex sensors possessing ion response function**

*Versatile Chiral Switching and Sensing Devices, Sensing Guest Anions in Water*

Poster Presentation, No.: 2-08

Fejos, I.; Kazsoki, A.; Sohajda, T.; Szente, L.; Beni, S.

**Stereospecific interactions between the four isomers of sexual potency enhancer tadalafil and various cyclodextrins**

*Cyclodextrin Modified Capillary Electrophoresis, Sulfobutylated α-Cyclodextrin*

Poster Presentation, No.: 2-28

Fejos, I.; Znaleziona, J.; Kazsoki, A.; Sohajda, T.; Szente, L.; Maier, V.; Beni, S.

**Enantioseparation of tapentadoli stereoisomers by cyclodextrin- modified capillary electrophoresis**

*Non-charged (2-hydroxy)propyl Cyclodextrins, Negatively Charged Hosts, Sulfated α-Cyclodextrin*

Poster Presentation, No.: 2-34

Yan, J.; Mao, Q.; Wang, Y.; Li, W.; Zhang, A.

**Oligoethylene glycol-modified thermoresponsive cyclodextrins**

*Phase Transition Temperature, Fluorescent Sensor*

Poster Presentation, No.: 5-03