NATIONAL INSTITUTE
OF CHEMISTRY

CATALYZING CHANGE

Our breakthrough innovations



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National Institute of Chemistry

The humble beginnings of the National Institute of Chemistry (NIC) date back to 1946, when it was established as the Chemistry Laboratory of the Slovenian Academy of Sciences and Arts. Since then, the institute has grown to become an internationally acclaimed research organization in the fields of chemistry, biochemistry, biotechnology, nanobiotechnology, synthetic biology, immunology, advanced materials, chemical reaction engineering and catalysis, and computer modelling. Our lines of work include not only scientific research, but also education and collaboration with the industry.



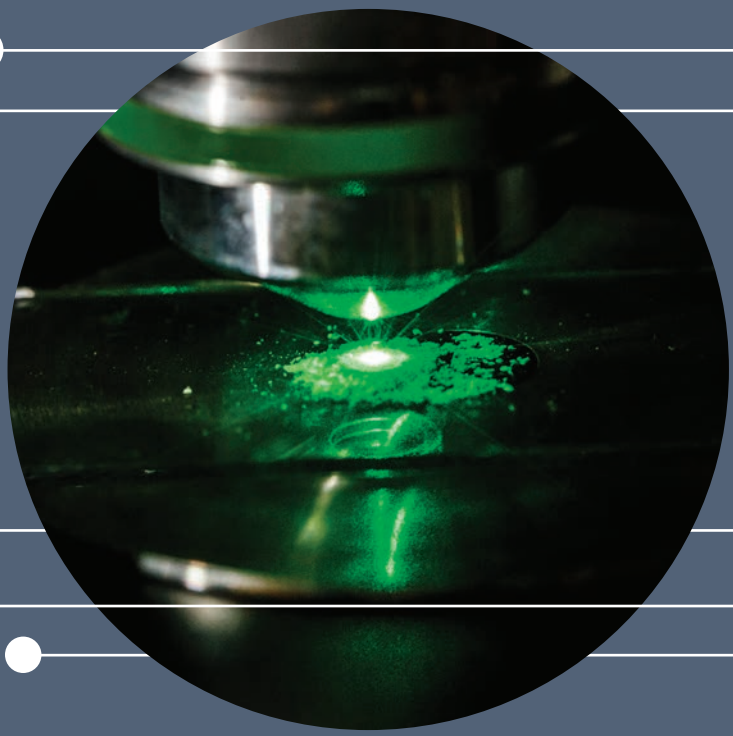
Improving the future one technology at a time

It is our mission to expand our understanding of the world around us, and use the knowledge gained to make it a better place. For our endeavors to succeed, the research we conduct and state-of-the-art technologies we develop must find their place in the industry. Only then can they unlock the benefits they hold for our society and drive the competitive advantage of our partner companies.

57	38	18
TECHNOLOGIES	**PRIORITY PATENT APPLICATIONS**	**INTERNATIONAL PATENTS GRANTED**

The innovative capacity of the NIC from 2019 up to 2024.

Our innovations span across five areas: advanced materials, analytical chemistry, chemical engineering, life sciences, and theoretical chemistry. Presented in this catalog some of the latest and most current technologies from our innovative portfolio.



ADVANCED MATERIALS

Advanced materials are engineered to have superior properties compared to conventional ones. With enhanced mechanical, thermal, electrical, or optical characteristics, they are suitable for cutting-edge applications across a wide range of industries, such as the energy industry and production of catalysts.

Catalyzed conversion of CO_2 and hydrogen into ethane and ethylene

Ethane and ethylene are widely used in the chemical industry, but their production typically relies on the use of fossil sources. With fossil fuels being phased out for their negative effects on the environment, green methods for the production of ethane and ethylene are highly sought after. Our technology makes it possible to synthesize both ethane and ethylene directly from carbon dioxide and molecular hydrogen.

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Department of Inorganic Chemistry and Technology

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IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development or IP licensing

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We have developed a new catalytic process for directly converting carbon dioxide and molecular hydrogen into ethane and ethylene. The process also produces carbon monoxide and methane as by-products. We have also designed a new catalytic material based on transition metals, which does not include iron, cobalt, or ruthenium. It operates best at a pressure of 1 bar and within a temperature range of 300–400 °C.



Our catalyzed process converts CO_2 and H_2 into C_2H_6 and C_2H_4.

The key advantages of our technology include high C2 productivity, as well as stable operation with no loss of catalytic activity within 50 hours' time on stream. The method also allows for a flexible feed with a wide range of carbon dioxide-to-hydrogen ratios and avoids the use of expensive noble metals, making the process more affordable.

Electrocatalyst for the hydrogen formation reaction

Thanks to its high energy density and environmental sustainability, hydrogen is emerging as a promising alternative to fossil fuels and a primary energy carrier. Carbon-free hydrogen production can be achieved through water electrolysis. In this process, hydrogen is generated via the cathodic hydrogen evolution reaction (HER), while the oxygen evolution reaction occurs at the anode.

DEVELOPED BY
Department of Materials Chemistry

TRL3

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development, IP licensing, or sale

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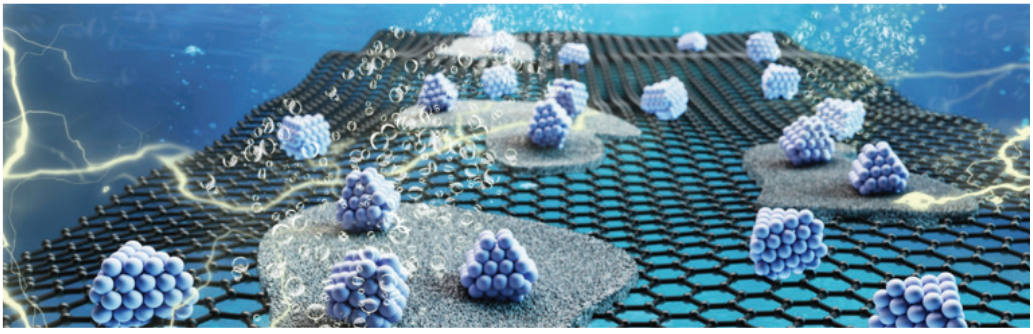
Our technology introduces a new electrocatalytic composite for HER, featuring ruthenium (Ru) nanoparticles supported on a titanium oxynitride (TiON) composite, with or without graphene, and utilizing a low metal content. The enhanced performance of the Ru/TiON catalyst is due to the precise design of the material, where each component plays a crucial role.



Ruthenium nanoparticles supported by a TiON composite on a layer of graphene.

The Ru/TiON catalyst enables more efficient hydrogen evolution reaction (HER) operation in alkaline electrolytes compared to the Pt/C catalyst. For instance, the potential required for HER at a current density of 10 mA/cm^2 is lower, and Ru/TiON offers a nearly four times higher mass activity. Aside from being more efficient, our catalyst is also more affordable since Ru currently comes at half the price of Pt.

Lignin-based epoxy resins with improved mechanical properties

Epoxy resins are widely used in various high-performing (e.g., structural) and commodity products. They are frequently found in electronics, metal coatings, composites, plastics, and adhesives. Currently, the epoxy resin market is dominated by materials containing bisphenol A and other chemicals harmful to the environment. Lignin can be employed to overcome this issue without sacrificing any mechanical and thermal properties, but since it is not reactive in its native form, a functionalization step is required first.

DEVELOPED BY
Department of Catalysis and Chemical Reaction Engineering

TRL4

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Industrial testing and scale-up

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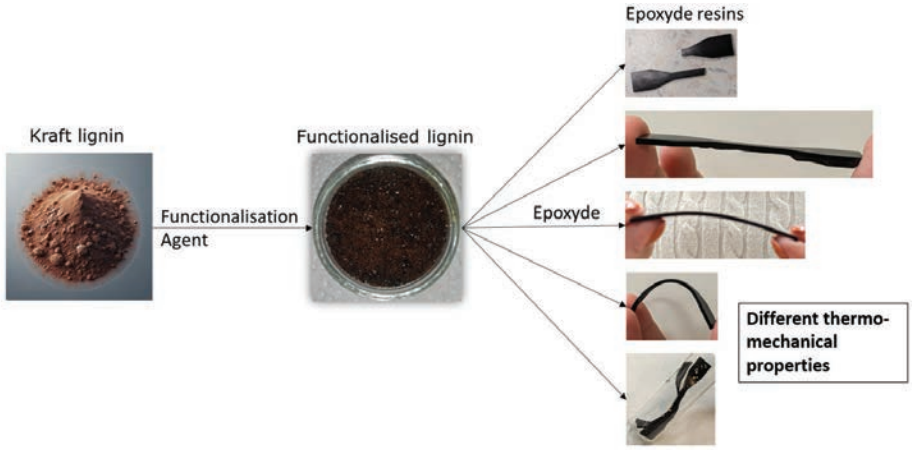
Our technology involves the preparation of novel epoxy resins using lignin in specific formulations. The epoxy resins proposed are composed of three components: a lignin, a functionalizing agent, and an epoxide. While lignin has been combined with an anhydride or epoxide before, literature on using a combination of all three components is extremely limited.



Functionalization of a lignin before the addition of an epoxide.

Such novel epoxy resins can greatly support sustainable development and the establishment of a circular economy in various industries, such as automotive, construction, and electronics.

Thermochemical adsorbent APO-Tric extrudates for heat storage

Large-scale utilization of solar energy for heating and cooling applications depends on effective thermal energy storage that reduces the mismatch between energy supply and energy demand. Most known technologies for heat storage are associated with high thermal losses over long periods of time, exhibit accelerated degradation, or are not cost-effective. Our technology aims to overcome this challenge.

DEVELOPED BY
Department of Inorganic Chemistry and Technology

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IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development or IP licensing

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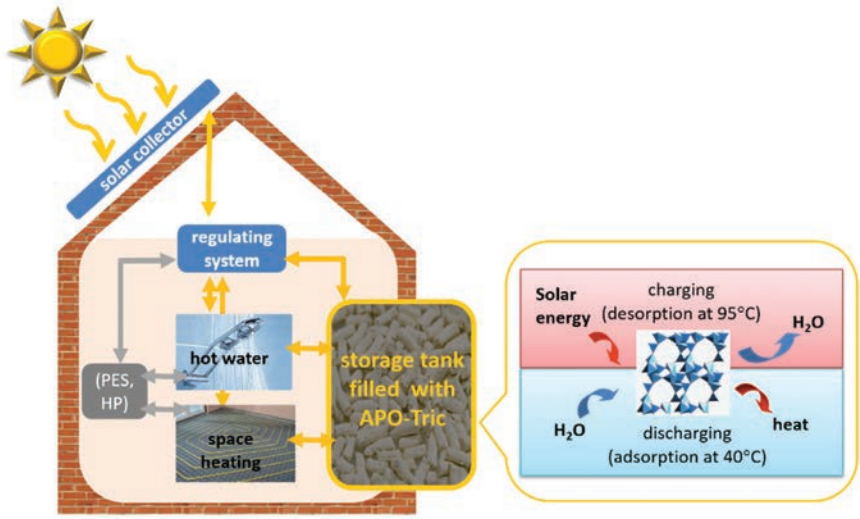
Thermochemical heat storage is a sustainable technology based on a reversible adsorption and desorption of gases on porous solids. Microporous aluminophosphates are excellent candidates as water adsorbents in heat storage applications.



Solar energy can be stored in adsorbents.

Our team has developed a method for preparing extrudates from the adsorbent developed years ago at our department. The adsorbent is the second-best water adsorbent among aluminophosphates for the sorption heat storage of solar energy.



ANALYTICAL CHEMISTRY

Analytical chemistry is a branch of chemistry that employs qualitative and quantitative analysis to determine the composition and structure of substances. It allows analytical chemists to provide insights and develop solutions for a variety of products, such as drugs, foods, and beverages.

Green synthetic platform for the preparation of various xanthophyll esters

Xanthophylls are oxygenated derivatives of carotenoids with many positive effects on human health. Some xanthophylls exhibit superior stability and bioavailability in esterified form compared to their free form. We present an energy-efficient and environmentally friendly synthetic platform for the preparation of various xanthophyll esters, paving the way for a new line of dietary supplements with increased efficacy and stability.

DEVELOPED BY
Laboratory for Food Chemistry

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TRL3

IP PROTECTION
Patent granted

BUSINESS OPPORTUNITY
Industrial testing and scale-up

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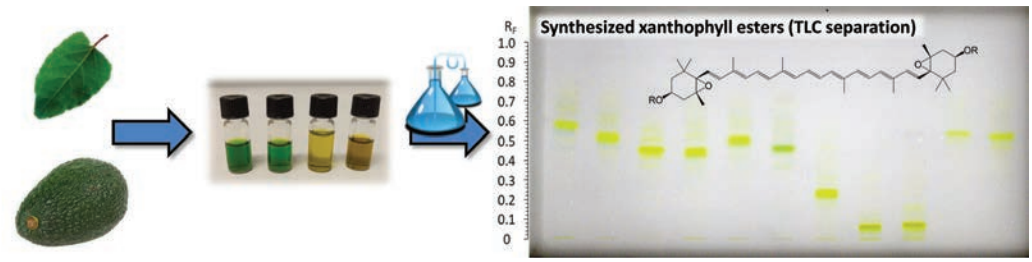
Using either an eco-friendly solvent or no solvent at all, we prepared 55 model xanthophylls. The reaction between free xanthophylls and acetic anhydrides took place on a laboratory scale under mild reaction conditions. We also developed a simple process for the purification of xanthophylls, which is based either on a liquid-liquid extraction using aqueous media or on solid-phase extraction by employing exclusively green solvents.



Our synthetic platform allows for xanthophyll's to be sourced from renewable natural materials.

Our synthetic platform allows for xanthophylls to be sourced from renewable natural meterials and used in dietary supplements. For selected model systems, it combines energy efficiency with a high reaction yield and high product purity. Another benefit of the platform is that unwanted side products are only formed in low amount.

Water-soluble cannabinoids with increased stability

Cannabinoids, such as CBD, have become an important global commodity. They have found their place in foods and beverages, cosmetics, and pharmaceuticals. The major problem of cannabinoids is their low water solubility, which largely restricts their use to to lipophilic mediums – mostly oil-based ones. Our technology unlocks aqueous solutions of cannabinoids and hemp resins with an increased stability and bioavailability.

DEVELOPED BY
Department of Analytical Chemistry

2023 NICKI SUPPORT RECIPIENT

TRL5

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development or licensing

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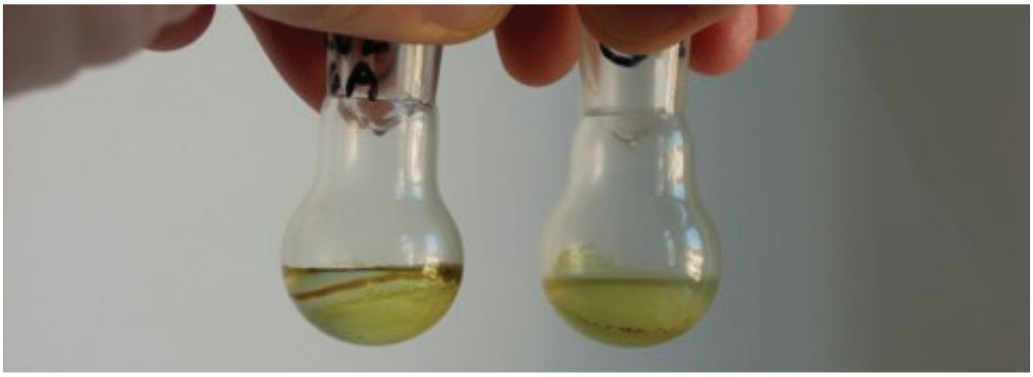
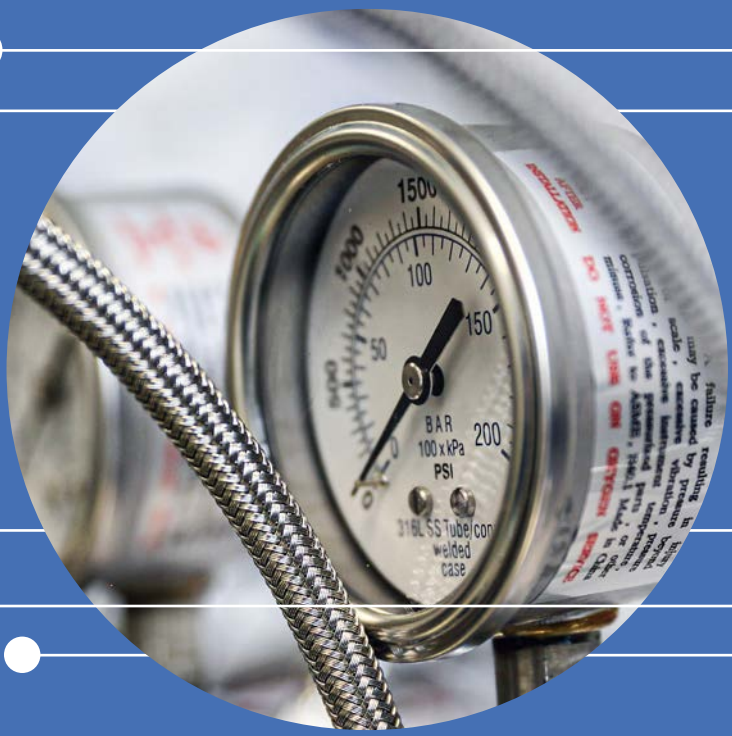
Established technologies for increasing the water solubility of cannabinoids typically involve lipophilic molecules that allow for emulsification – the process of mixing two liquids that do not mix under normal conditions. Our technology takes a different approach unlocking true solutions that are clear, stable, exhibit no sedimentation, and are relatively inexpensive to prepare.



The water solubility of an unmodified (left) and modified (right) hemp resin.

Our technology also makes crude cannabis resins soluble, significantly improving the usability of the technology. What is more, we have also observed that the technology increases the stability of relatively unstable acidic forms of cannabinoids, such as CBDA or CBGA. This is an important feature as these acidic forms are gaining market importance due to their unique properties.



CHEMICAL PROCESSES

Chemical engineering is a multidisciplinary field that deals with the design and management of processes that transform raw materials into valuable products. Its primary objective is to develop new chemical plants and optimize existing ones so as to make them more economically and environmentally sustainable.

Automatic modular gas diffusion catalyst screening system

Electrocatalysis research is typically performed on a trial-and-error basis, so a method for quickly and reliably characterizing the electrocatalytic properties of a material is highly sought after. Measurements are traditionally taken in a rotating disk electrode or obtained using a single cell with membrane electrode assembly, but they do not provide immediately applicable results or are time-consuming and expensive. To overcome these, challenges, we employed a gas diffusion electrode, which is gaining popularity in hydrogen economy applications.

DEVELOPED BY
Department of Materials Chemistry

TRL6

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development or IP licensing

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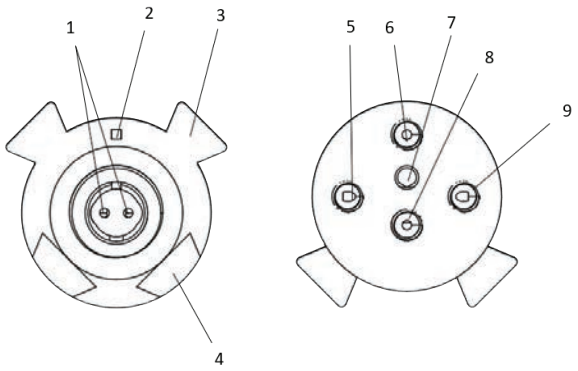
Our technology allows for quicker and more reliable measurements in industry-relevant conditions. It utilizes a so-called gas diffusion half-half cell as its core component and a gantry that moves the reference and counter electrodes to different cells. The system is automatic and modular, with its size and the speed of measurement depending on both the gantry size and the number of channels of the potentiostat taking the measurements.



1 – gas inlet/outlet
2 – electrical contact exit
3 – male interlocking part
4 – female interlocking part
5 – gas inlet/outlet
6 – temperature regulation inlet/outlet
7 – temperature measurement
8 – temperature regulation inlet/outlet
9 – gas inlet/outlet

A gas diffusion half-half cell according to our invention.

The system provides a lot of data, making it ideal for machine learning or the design of 2D experiments. Since it is automatic, it boasts high speed, reproducibility and productivity. At the same time, it minimizes human error, maximizing the reliability of the data obtained.

Chemical recycling for recovering raw materials from polyurethane waste

Polyurethane foams (PUFs) are used in comfort applications and as insulation materials. They are bulky materials with a cross-linked structure. Therefore, conventional waste management methods like incineration, landfill disposal, and mechanical recycling are not ideal for handling this type of polymer waste. Chemical recycling of PUFs offers a sustainable approach to recovering raw materials with high added value.

DEVELOPED BY
Department of Polymer Chemistry and Technology

TRL3

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development and scale-up

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Our chemical recycling process uses a cheap, dual-acting reagent that allows efficient degradation of the urethane groups in the PUF structure, while producing a small amount of aromatic diamine as toxic by-product. The process is carried out in bulk without catalyst, solvent or other media. The isolation of the recycled polyols is simple and efficient and is carried out in a closed loop system, minimizing both the economic and environmental impact. Crude polyols obtained in this way can be used directly or purified further, depending on the end product requirements. Recycled polyols can be used as feedstock for the production of new flexible PUFs or other polymer products.



Our technology supports a circular economy in the production of PUFs.

Liquid-phase process for the production of acrylic acid esters from glyceric acid

Acrylic acid and its esters are vital in the chemical industry, particularly for polymer manufacturing. To address the growing demand and reduce reliance on the conventional propylene oxidation process derived from fossil resources, this disclosure presents a novel catalytic method. Our method efficiently produces acrylic acid, propanoic acid, and their esters from bio-based glyceric acid or its derivatives in alcohol, using a solid catalyst in an inert atmosphere without the need for additional reducing agents.

DEVELOPED BY
Department of Catalysis and Chemical Reaction Engineering

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IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Scale-up, joint development, IP licensing, or sale

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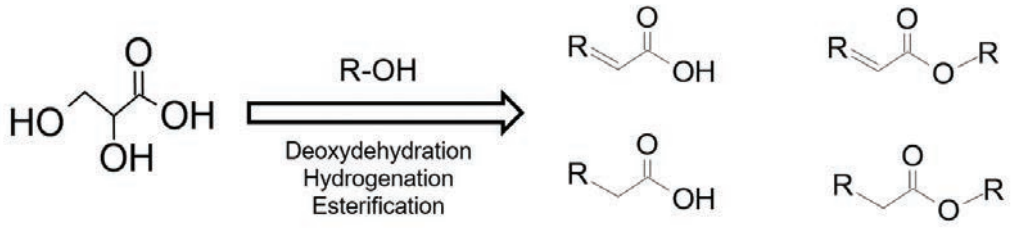
This invention features the use of a solid catalyst, enabling catalyst recycling and the establishment of a continuous process. It eliminates the need for additional reducing agents, particularly hazardous hydrogen gas, and combines deoxydehydration, hydrogenation, and esterification. This results in the production of easily recoverable and industrially sought-after acrylate esters as the primary products.



Our process of producing acrylic acid esters from glyceric acid.

Our production method ensures high selectivity and yields in a simplified process, where acrylic esters are efficiently produced in a one-pot process. It also unlocks a wide range of production as it enables the use of various alcohols, such as methanol, ethanol, and propanol, in the synthesis of various acrylates and propanoates.

Rapidly scalable H_2 storage and production through ammonia and hydrogen conversion by using magnetic heating

The increasing impact of fossil fuels calls for new carbon-free energy sources like hydrogen. However, stable and reversible storage methods are required due to its hydrogen's volatility. Ammonia is a good candidate, but its traditional catalytic decomposition is slow and requires external heating. This invention leverages magnetic (induction) heating for a quicker and efficient ammonia synthesis and decomposition.

DEVELOPED BY
Department of Catalysis and Reaction Engineering, NIC; Materials Synthesis Department, JSI

TRL4

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Industrial testing and scale-up

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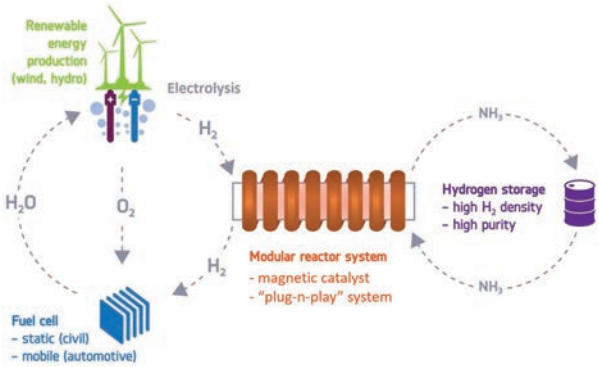
This invention uses structured, magnetically heated catalysts for an efficient ammonia synthesis and decomposition. It encompasses a reactor system for gas-phase magnetic catalysis as well as catalyst materials and their preparation procedures. By addressing the challenges of hydrogen storage, it facilitates the adoption of renewable energy sources and enhances the efficiency of hydrogen-based applications.



A fuel cell with catalytic ammonia and hydrogen conversion.

The main benefits of our technology include rapid and precise temperature adjustments crucial for integration with renewable energy sources, as well as increased efficiency due to a minimized heat transfer distance and temperature gradients. The invention thus allows for a flexible and on-demand hydrogen gas production for applications like fuel cells and internal combustion engine.

Sustainable production of allyl alcohol

Allyl alcohol is an industrially important substance, primarily used as an intermediate in the production of various organic compounds. Current processes for the production of allyl alcohol are based on fossil fuels and thus environmentally unfriendly, and they also tend to be expensive. Our technology allows us to synthesize allyl alcohol from glycerol in a sustainable and cost-effective way.

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Department of Catalysis and Chemical Reaction Engineering

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BUSINESS OPPORTUNITY
Industrial testing and scale-up

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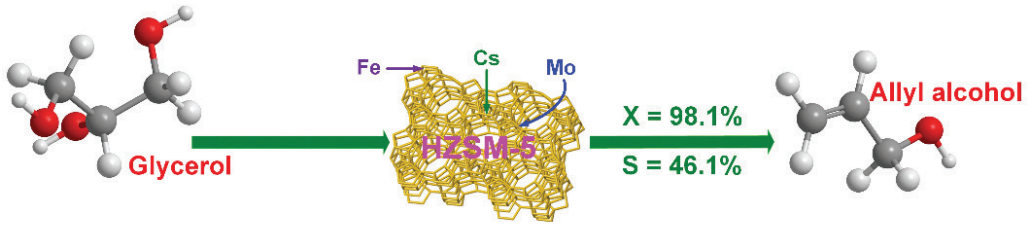
Our method of producing allyl alcohol involves a special catalyst containing three metals (iron, cesium, and molybdenum). This catalyst makes it possible to convert glycerol to allyl alcohol in a fixed-bed continuous flow reactor, meaning that the catalyst is statically arranged inside the reactor constantly fed with gaseous glycerol. The reaction takes place at atmospheric pressure and temperatures ranging from 250 to 400 °C.



Allyl alcohol synthesis from glycerol using our catalyst.

Our method of allyl alcohol production is economically more viable than other known solutions as it occurs in one single step and takes place at a lower temperature and pressure. What is more, we have eliminated the need for fossil fuel derivatives, making the production of allyl alcohol more sustainable. We have also eliminated the need for a hydrogen donor and unlocked a green method for synthesizing glycidol from glycerol.

Synthesis of ellagic acid from ethyl gallate using hydroxides and deep eutectic solvents

People are becoming more conscious of the significance of a healthy lifestyle and the role that natural plant products play in it. One such important natural compound is ellagic acid (EA), a polyphenolic compound found in various fruits, vegetables, and other plant sources. EA has antioxidant, anti-mutagenic, anti-carcinogenic, anti-inflammatory, and antimicrobial properties.

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Department of Catalysis and Chemical Reaction Engineering

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Patent pending

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Joint development, IP licensing, or sale

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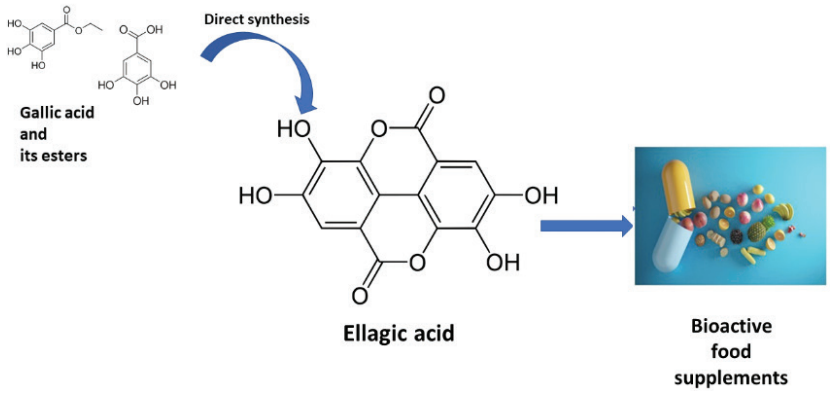
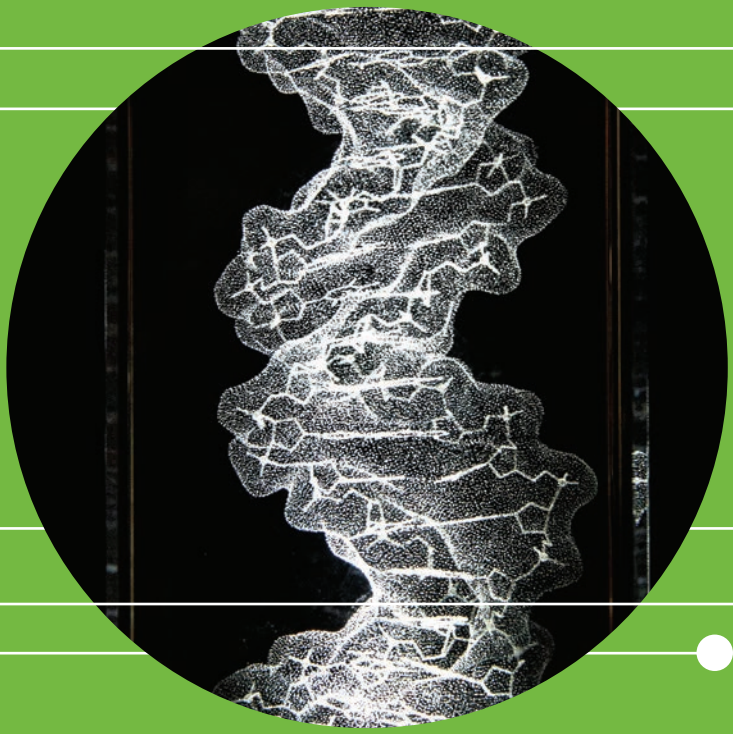
Our invention describes a novel process for the efficient synthesis of this bioactive polyphenolic compound from gallic acid esters, such as methyl gallate, ethyl gallate, and propyl gallate. Our production method uses a combination of an alkaline solution, eutectic solvents, and a gas mixture.



Ellagic acid synthesis from gallic acid and its esters according to our technology.

Our technology ensures a high yield and purity, even on larger scales where it maintains a 61.8% yield. What is more, the reaction protocols are simple, which ensures the approach is both accessible and reproducible.



LIFE SCIENCES

Life sciences is a multidisciplinary field that studies living organisms and their interactions with the environment. Research in life sciences has wide-ranging applications, allowing us to develop new medical treatments, improve food quality and safety, as well as solve various ecological challenges.

Artificial receptors based on the functionalization of planned protein nanostructures

Glycans are carbohydrates or carbohydrate portions, comprised of a large number of monosaccharides. They are particularly relevant in medicine, where different glycosylation patterns are indicative of different medical conditions, such as tumors or viral infections. Developing a technology for the detection of various glycosylation patterns would thus greatly aid diagnostics.

DEVELOPED BY
Department of Synthetic Biology and Immunology

TRL3

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development or IP licensing

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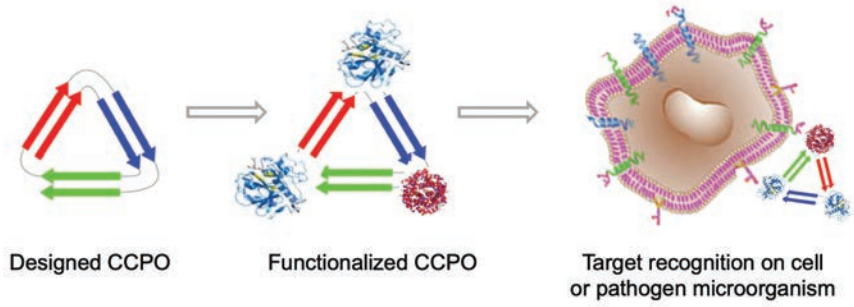
We have upgraded our innovative approach to designing new types of protein nanostructures based on a defined sequence of interconnected segments. In pairs, these form coiled-coils that assemble into a designed de novo coiled-coil protein origami (CCPO). Such a structure serves as a stable framework for the attachment of various bio-specific protein domains with target recognition, for example glycan recognition domains.



Functionalized CCPO capable of target recognition on cells and pathogen microorganisms.

Our technology includes the development and production of CCPO and its functionalization with lectins, a group of proteins that can recognise various glycans specific for certain viral infections, pathogenic microorganisms, tumour cells or other diseases. In addition to its high analytical sensitivity, our technology has another advantage: lectins can also interact with glycans that are still bound to proteins or cells.

Design of a bilayer mucoadhesive film for the delivery of vaccines or nucleic acid-based therapeutics

Vaccines are typically administered using intramuscular injections, which is not optimal when it comes to respiratory infections. In such cases, the upper respiratory tract is the entry site of pathogen invasion, thus strong immune response should be ensured onsite. Our invention increases mucosal immunity in the upper respiratory tract with a buccal booster dose following an initial intramuscular injection.

DEVELOPED BY
Department of Synthetic Biology and Immunology

TRL4–5

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development or IP licensing

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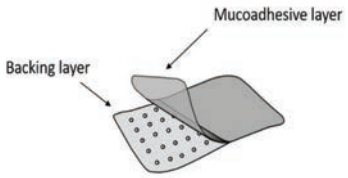
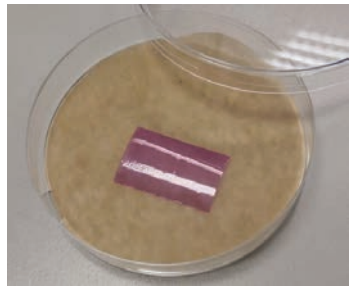
We present a novel approach for delivering vaccines and other therapeutic nucleic acids, which uses mucoadhesive films consisting of two layers. The first is a mucoadhesive layer with the active ingredient, which ensures a targeted dissolution through the buccal mucosa within 30–60 minutes. The second one is an impermeable layer that prevents losses in the oral cavity, thereby enhancing absorption.







The technology allows for vaccines to be administered as oral strips.

The key advantage of our technology is that a combination of specific polymers also enables tailored dissolution profiles, allowing for either a rapid or controlled release of the active ingredients. Another benefit is accessibility. By eliminating the need for needles, vaccination programs can become more affordable, safer, accessible, and more acceptable for those who are afraid of needles.

Chemically inducible split protein actuators

The invention relates to chemically inducible split protein actuators (CISPAs), particularly to their design, manufacture, structure, and uses. The method of engineering CISPAs utilizes ligand-binding proteins or protein domains originating from humans or other organisms, which are rationally split into two fragments that reassemble only in the presence of a cognate ligand, which is typically a small molecule. The designed CISPAs can be used to regulate cellular processes, such as gene expression, as biological sensors, or for other applications.

DEVELOPED BY
Department of Synthetic Biology and Immunology

TRL4

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development, IP licensing, or sale

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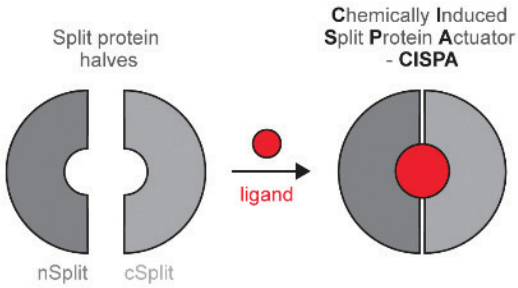
The designed CISPAs are preferably based on human-derived ligand-binding proteins, which are divided into two fragments that reassemble in the presence of a selected ligand. Thus, the interaction between the split protein fragments is controlled by the presence of the selected ligand. This strategy of CISPA design is inspired by rationally designed split proteins, but unlike previous split proteins, we use ligands that originally bind these intact proteins to induce the reassembly of split fragments. CISPAs can be used as biological actuators or as sensors for in vitro and in vivo detection of selected ligands and respond directly using different reporter output signals or function or change of property.



Reconstitution of split protein fragments in the presence of a selected ligand.

Our engineered CISPAs are based on human-derived proteins or protein domains, which are suitable for therapeutic applications. The engineering principle for the design of CISPAs is universal and can be used to create novel CISPAs based on almost any ligand-binding domain.

Coiled-coil mediated tethering of CRISPR/CAS and exonucleases for enhanced genome editing

The global gene editing market is propelled by various applications, ranging from the discovery of new pharmaceuticals to genetic engineering of plants and microorganisms. Also popular are accessible gene editing tools. CRISPR/Cas is an important one due to its multiplexing ability and relatively easy design. Our technology improves gene editing with CRISPR/Cas by enabling the modification of a larger part of the genome.

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TRL4

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Joint development, IP licensing, or sale

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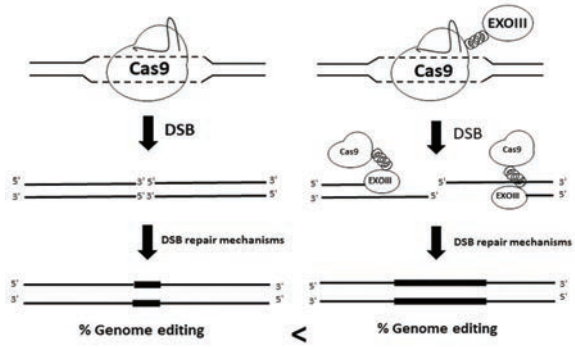
Our technology builds on CRISPR/Cas with tethering – the attachment of a molecule to the Cas9 protein. In our case, the molecule tethered to Cas9 was exonuclease III (EXOIII). We achieved tethering in a cell using heterodimeric peptide pairs linked to Cas9 and EXOIII, which form a coiled-coil due to hydrophobic and electrostatic interactions between the peptides. Cas9 subsequently brings EXOIII into close proximity of the double stranded breaks (DSB). This allows for additional DNA recession, leading to different 5' overhangs with greater mismatches in template and non-template DNA strands, resulting in higher indel mutations.



CRISPR/Cas9 gene editing with and without EXOIII tethering.

Our technology allows for a simple tethering of various exonucleases with Cas9 and its variants via coiled-coils. This improves DNA recession and enables a higher percentage or degree of genome modification. No additional increase in off-target effects has been observed and the technology does not induce cytotoxicity.

Design of a split-superantigen for a safer cancer immunotherapy

The global cancer immunotherapy market is growing due to an increasing incidence of cancer. One of the potential therapies involves superantigens (SAg) – proteins produced by bacteria or viruses that are among the most potent activators of the immune system. Strong T cell activation is one of the main weaknesses of this strategy as it may lead to systemic T cell activation. Our technology aims to solve this challenge.

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TRL3

IP PROTECTION
Patent granted

BUSINESS OPPORTUNITY
IP licensing

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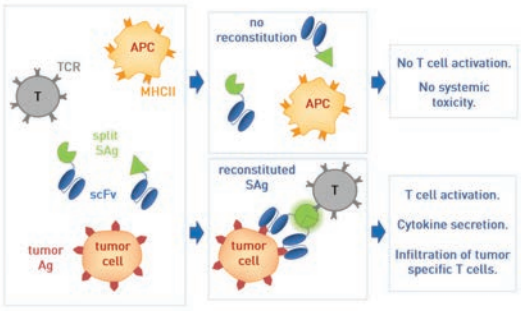
Our SAg of choice was a highly potent and well characterized staphylococcal enterotoxin A (SEA) from S. aureus. Proof-of-concept fusion proteins were designed, where individually inactive split SAg fragments were genetically fused to a single chain variable fragment against B cell antigen CD20 (scFv–CD20). The binding of scFv fused with split SAg fragments to target tumor antigens brings the inactive split SAg fragments into close proximity, so they can reassemble into a biologically active form to trigger a T cell response. This strategy opens the possibility of linking split SAg fragments with two different antibodies, each specific for a different tumor antigen, which could increase the selectivity for tumor cells.



Representation of split superantigens in cancer immunotherapy.

Our technology makes it possible to target tumor cells without affecting healthy cells, overcoming systemic immune activation and dose-limiting toxicity. Additional benefits include high specificity by linking split SAg fragments with antibodies – possibly ones that are widely used in clinical practice for cancer treatment – and a screening technique for detecting SAg with a favorable splitting site to retain its efficacy.

Hydroxychloroquine-containing pharmaceutical formulations for vaccine and gene therapy

Nucleic acids are quickly gaining grounds in disease treatment and prevention, for instance as therapeutics in gene therapy and as preventive medicine in vaccines. However, their use is associated with inflammation and other undesired side effects. Our innovation aims to reduce these negative side effects by combining nucleic acids with hydroxychloroquine (HCQ) or its analogs.

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Department of Synthetic Biology and Immunology

TRL4–5

IP PROTECTION
Patent pending

BUSINESS OPPORTUNITY
Clinical trial, IP licensing, or joint development

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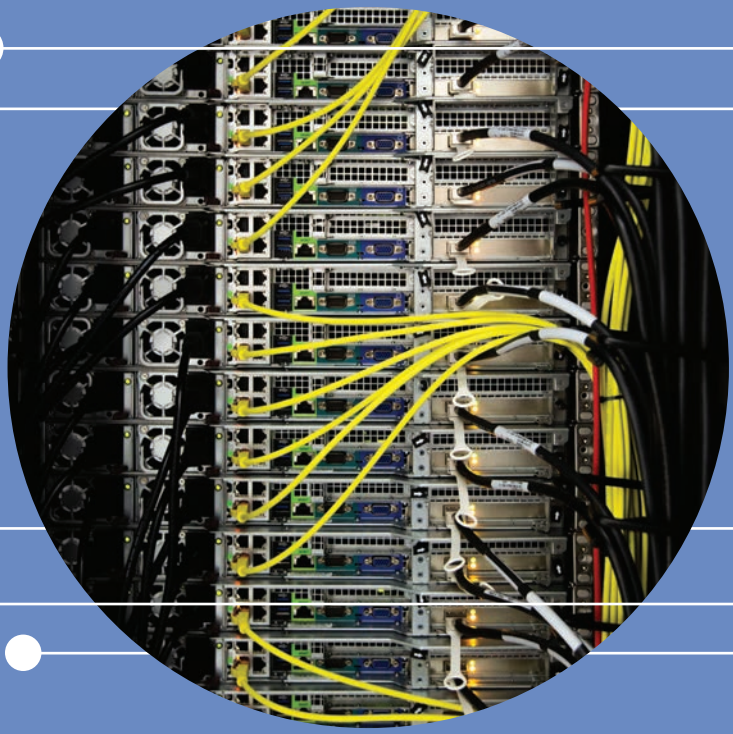
HCQ is a widely used drug with a few side effects. When administered with nucleic acids, it binds to them and reduces their recognition by cellular receptors. Our novel pharmaceutical formulation thus reduces inflammation and minimizes the undesired side effects associated with nucleic acid therapies without compromising their therapeutic efficacy.

Our approach can be applied to a wide range of nucleic acid-based treatments, including mRNA vaccines and gene therapies, enhancing their safety and improving patient tolerance. The formulation can be added to any type of nucleic acid therapeutics and be administered either as a single mixture or via a combined oral-injection route, providing versatility in therapeutic applications.



Our formulation has multiple applications, including vaccines and gene therapy.



THEORETICAL CHEMISTRY

Theoretical chemists use mathematical models, simulations, and computational techniques to explain and predict the behavior of chemical systems. This allows them to explore phenomena that are difficult to observe experimentally, helping them design new substances, such as advanced anticancer drugs.

Substituted bithiazoles for safer combinational chemotherapy treatments

Cancer remains one of the most widespread and deadly diseases, with nearly 10 million deaths and 20 million new cases reported annually by the WHO. A key target in cancer treatment is DNA topoisomerase IIα, an enzyme critical for managing DNA topology during cell replication. However, current topo II inhibitors, known as topo II poisons, are linked to severe side effects, including cardiotoxicity and secondary cancers, due to their tendency to induce double-strand breaks (DSBs) in DNA, which complicates treatment and limits therapeutic use.

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Theory Department

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Joint development, IP licensing, or sale

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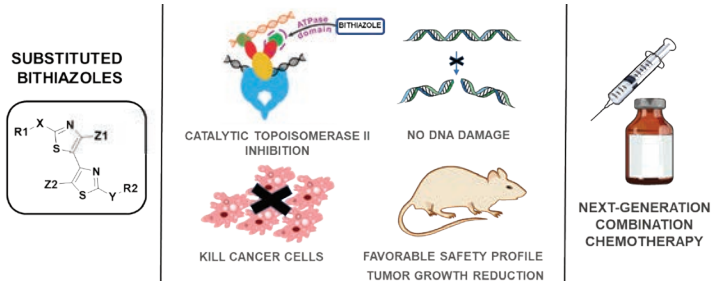
A class of substituted 4,5'-bithiazoles, unlike conventional topoisomerase II poisons, inhibits human topoisomerase IIα through an alternative ATP-competitive mechanism. These compounds retain cancer cytotoxicity levels comparable to clinical topo II poisons but avoid inducing double-strand breaks (DSBs), potentially reducing harmful side effects. In vivo studies show that bithiazoles exhibit a favorable safety profile, both as monotherapy and in combination with topo II poisons. Efficacy studies demonstrate that bithiazoles reduce tumor growth in mouse models and enhance therapeutic outcomes when combined with topo II poisons.



Substituted bithiazoles for enhancing chemotherapy regimens of established anticancer drugs.

Bithiazoles can be incorporated into current chemotherapy regimens, alongside established anticancer agents such as topoisomerase II poisons, type I topoisomerase inhibitors, and protein kinase inhibitors, to enhance therapeutic efficacy. This approach positions bithiazoles as a next-generation solution for combination chemotherapy, potentially improving patient outcomes.

Our knowledge, your opportunity

Innovations presented in this catalog differ from one another in the level of technology readiness. Most importantly, none of them have been fully developed to TRL9, so there is still some research, testing, and development to be done before they can see the light of day in an industry setting.

If you want to upgrade your product portfolio or optimize an existing production process with any of our technologies, keep this in mind when deciding what kind of cooperation you would like to pursue. There are three different options that you can choose from:

1. Development cooperation

As mentioned, most of our technologies are still in the development phase. This is why the most common way we transfer technologies is through industry cooperation, either within project consortia or through direct research and development contracts. Such a joint development allows us to reach a higher level of technology readiness, while constant industry inputs improve the success of commercialization.

2. Licensing

Another way of getting your hands on one of our technologies is through the licensing of intellectual property rights. As you sign a license, the NIC grants you the right to market the corresponding technology against the payment of royalties. These are normally determined as a percentage of the sales of a product or service containing licensed intellectual property. Such a license can be either exclusive or non-exclusive.

3. Patent purchase

The last path to our technologies is by purchase of the corresponding patent. This option involves a high one-time payment as compensation for the NIC giving up the possibility to license the technology to other partners. When purchasing a patent, you become the sole owner of the innovation and the right to licensing the technology falls into your hands.

Knowledge Transfer Office

Has any of our technologies sparked your interest? To schedule a meeting with our representatives or the research team behind the innovation, get in touch with the Knowledge Transfer Office:

knowledge.transfer@ki.si

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RTIT>>

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Energy storage and conversion



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Knowledge Transfer Office

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