

IN THE NAME OF ALLAH



Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The 37th
Khwarizmi International Award

The 2nd
**Khwarizmi Innovation and
Technology Award**

February 2024

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
يَرْفَعُ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ
وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ
بِمَا تَعْمَلُونَ خَبِيرٌ

In the Name of Allah

"Allah will raise up in ranks
those who believed among
you and those who have
been given knowledge.
Allah is aware of what you
do."

Holy Qur`an,
Surah al-Mojadele, Ayah 11



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Minister's Foreword



The National Five-Year Economic, Social, and Cultural Development Plan focuses on promoting the manufacture of knowledge-based products. Developing a knowledge economy relies on the establishment and growth of knowledge-based companies. Recognizing that experts are the valuable human capital of a society, policymakers, and public officials should take a responsible approach toward fulfilling their scientific, technical, economic, and social needs, and develop a road map to address these requirements.

The Khwarizmi Awards, organized annually by the Iranian Research Organization for Science and Technology (IROST), are a thoughtful approach to recognizing exceptionally talented individuals and their worthwhile projects that contribute to the progress of the country. It also aims to introduce intellectuals, researchers, innovators, and technologists. The procedures and accomplishments of the Awards bring about a sense of vitality and hope while developing self-confidence and a sense of national identity among the country's invaluable human capital.

Moreover, providing full support to scholars, innovators, technologists, and researchers engaged in scientific and industrial fields is crucial. Efforts should be made to commercialize the research results and facilitate the creation of wealth from knowledge to achieve sustainable development. The effectiveness and efficiency of national research and innovation projects rely on their commercialization. Thus, research and innovation results can create added value and contribute to national development.

Finally, I would like to express my appreciation to the President of IROST, the Scientific Committees, the Executive Committee of the Khwarizmi Award Secretariat, and the many colleagues in different departments of the Ministry of Science, Research and Technology for their contributions towards organizing this prestigious Award for the past thirty-seven years.

Professor Mohammad Ali Zolfigol
Minister of Science, Research and Technology

Chairman's Foreword



Science and technology play a significant role in promoting sustainable development and in building innovation capacity, both of which are necessary for fostering a dynamic society. The crucial role of knowledge-based companies in the economic and technological development of innovation networks highlights the importance of establishing such companies in developing societies. The activities of these companies, such as increasing productive employment, meeting the demands of domestic industries, creating knowledge-based products, exporting goods, and facilitating technology transfer from universities to industry contribute to the production of advanced technologies.

Large, established industrial companies have an advantage in innovative and technological capabilities over the newly established ones. However, these new companies can also develop their technological capabilities by promoting research and development activities and accumulating technical knowledge over time. This process ensures fair competition in the industrial society for technology advancement. The Iranian Research Organization for Science and Technology (IROST) has had a great achievement in the past thirty-seven years through organizing the Khwarizmi Awards. By accepting applications focused on research projects, IROST has successfully recognized and introduced the best knowledge-based initiatives, while supporting innovators and technologists. IROST, as the organizer of this international scientific event, remains committed to maintaining the values represented by this science competition just as it has been in previous years.

In this edition of the Awards, having received hundreds of research projects at national and international levels, we have witnessed the improvement of science and technology and the encouragement of dialog between world-renowned scientists.

I appreciate all the colleagues at IROST, the Permanent Secretariat of the Khwarizmi Awards, Members of the Scientific Committees, Experts, the Grand Jury Members, and National and International Sponsors who have supported the Khwarizmi Awards.

Professor Hassan Zamanian
Chairman
The Khwarizmi Awards



Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The Laureates of the **37th** Khwarizmi International Award

Research Work Title

Design and Synthesis of Bifunctional Compounds and Their Capability in the Synthesis of Organic Compounds



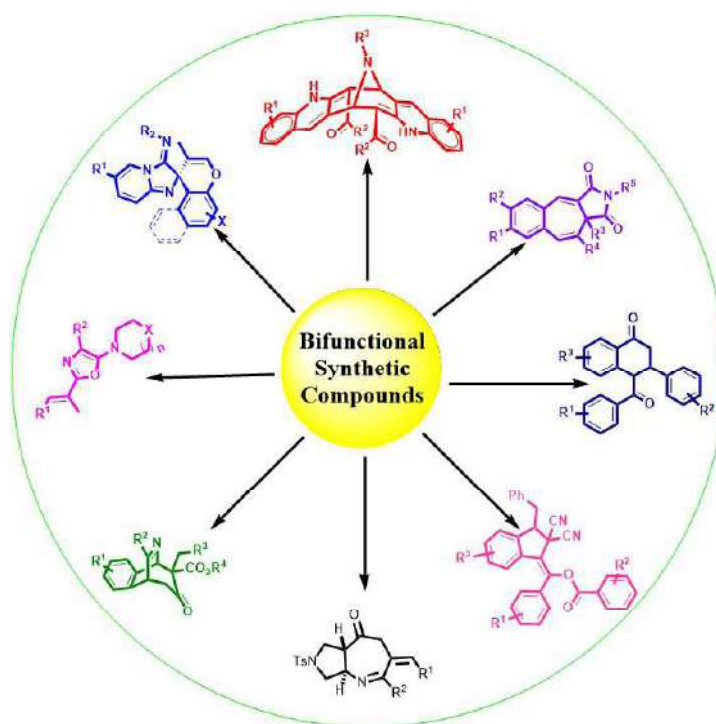
Researcher | Saeed Balalaie

Collaborators | Kamran Amiri, Hormoz Khosravi, Saeideh Rajaie Daryasari, Ali Nikbakht

Collaborator Organizations | Peptide Chemistry Research Institute, K. N. Toosi University of Technology and Kimia Pajouh Dorsa Company

Abstract

In the field of organic chemistry, it's not impossible to synthesize any product, however, the most important aspect is to design a suitable synthetic route that reduces the number of reaction steps, has a high atom economy, and results in the synthesis of functionalized targets, all while being environmentally friendly. One approach to achieving this is by designing cascade reactions using bifunctional compounds. In recent years, we have focused on synthesizing bifunctional compounds to obtain novel, complex compounds with biological activities through cascade and stepwise reactions. The advantages of these reactions include high bond-forming efficiency, high atom economy, high diastereoselectivity, mild reaction conditions, and easy separation and purification. Not only are these methods effective for the synthesis of complex and functionalized compounds, but with the experience gained, it's also possible to prepare many active pharmaceutical ingredients and materials with high added value.



Research Work Title

Providing Effective Models Based on the Principles of Green Chemistry to Optimize Chemical Processes

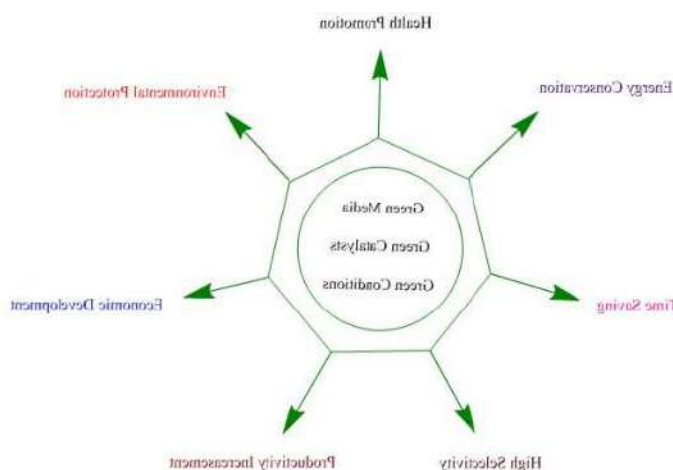


Researcher | Farhad Shirini

Collaborating Organization | University of Guilan

Abstract

The research focuses on the diverse catalysts that are effective in organic reactions, including the sodium chloride, potassium bromide and calcium chloride, and those that can be easily prepared, such as hydrogen sulfates, new types of nano-catalysts (especially types with magnetic capabilities), nanocomposites, metal-organic frameworks, a wide range of ionic liquids and natural deep eutectic solvents, as very effective and inexpensive catalysts with significant efficiency in a wide range of organic reactions, especially multi-component ones.. Furthermore, the research highlights natural catalysts, including rice husk , rice husk ash, and Shal Tasbih plant powder as a weed found in the forest areas of Guilan province, Verjuice, orange peel powder, taurine, pregabalin, and caffeine. These catalysts are particularly useful in the preparation of polycyclic heterocyclic compounds, given their high selectivity and ability to perform asymmetric induction reactions. The research also addresses the critical issue of catalyst stabilization, particularly for nano-catalysts with the ability to be agglomerated, ionic liquids, salts with a predisposition to absorb moisture, and some natural compounds with the ability to oxidize. This project suggests a significant number of the catalysts under examination can be utilized in industrial settings, including for the treatment of industrial wastewater and carbon dioxide absorption. Some of these catalysts are also leveraged in drug delivery processes for breast cancer treatment. On the other hand, a number of heterocyclic products have demonstrated exceptional antibacterial activity.



Research Work Title

Breeding Almonds to Produce Fruitful and Cold-Resistant Late-Flowering Cultivars



Researcher | Ali Imani

Collaborating Organization | Agricultural Research Education and Extension Organization

Abstract

The almond breeding program has resulted in the creation of superior genotypes and over a thousand hybrids, through the selection of native almond germplasm and hybridizing since 1991. During 1991 and 1992, the program obtained commercial genotypes of selected late-flowering cultivars at the Sahand station. After the initial evaluation of 20 cultivars, two promising hybrids were selected for introduction in the horticultural research stations and were named Araz and Iskandar. In the second phase of the almond breeding program, which started in 2010, the program began complementary selection of native almond germplasm and cross-breeding. As of now, over a thousand hybrids and genotypes have been studied, and two cultivars Aydin and Saba have been introduced. Additionally, 6 Italian self-fertile cultivars, as well as some commercial cultivars were evaluated. The program found that Tuono and Supernova cultivars were superior self-fertile cultivars, and the Ferragnès cultivar (Shahrood 12) was suitable for cultivation throughout the whole country. The development of improved and late-flowering almond cultivars can have good economic effects. Improved cultivars have a significant income difference compared to native ones. With correct planning, the use of appropriate technology, horticultural knowledge, and advanced horticultural methods, the area under cultivation and production of almonds can be increased.



Research Work Title

An Innovative Process for Monitoring Frequency Interference and Estimating the Location of External Sources in the Mobile Phone Network

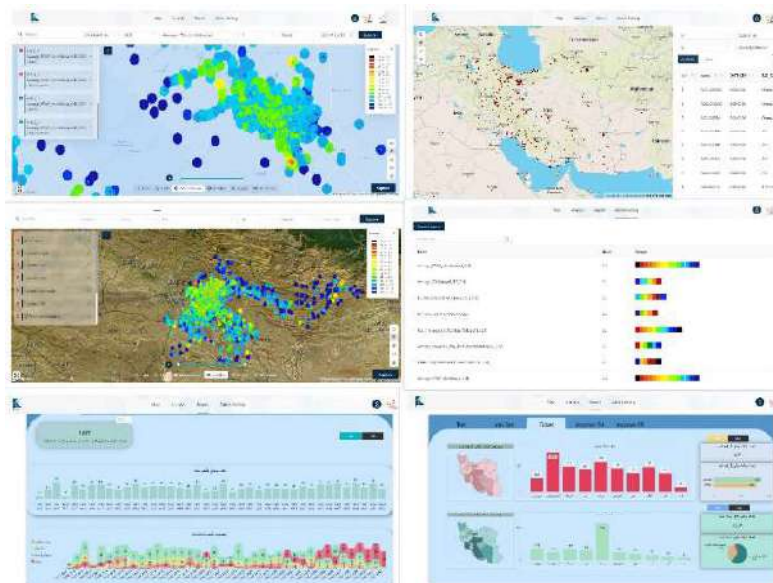


Representative | Abbas Azari

Collaborating Organization | Naghshe Aval -e- Keyfiyat Company

Abstract

“Kashef” is an intelligent web-based software tool designed to locate frequency interference sources on a map, using quality indicators of the mobile network without imposing any hardware on it. By continuously monitoring the network, Kashef speeds up the discovery of interference factors and enables targeted detection of the range of disturbing sources of frequency interference in less time. Using Kashef software is economical in terms of human resources. It enables the shortest and fastest possible way to discover and approximate the location of the frequency interference factor, making it an efficient tool for mobile phone service providers. The software uses location-based data mining to monitor the frequency spectrum in cellular networks. This involves combining data related to frequency spectrum extracted from OSS mobile network operation support systems with physical information of telecommunication sites within a short time. This information is displayed on a map continuously and in a user-friendly manner. The purpose of this method is to detect the causes of frequency disturbances in mobile networks. Kashef has several achievements, including reducing damages caused by interference factors in the network, reducing the consumption of equipment and side costs, regulating the quality of coverage at a standard level based on spatial data mining, rapid identification of illegal sources and interference, and automatic daily anomaly detection.



Research Work Title

Introduction to Spruce Populations Tolerant to Surface Powdery Mildew



Researcher | Mohammad Ali Alizadeh

Collaborators | Ashraf Jafari, A. Nourmand Moayed, F. Sepahvand, K. Davazadah Emami, S. Seyfollahi, A. Naseri, B. Moeini, M. Mohammadi, B. Palooch, A. Arefipour, M. Amir Khani, M. Pahlavani, M. Seyedian, E. Zaynali, H.

Collaborating Organizations | Agricultural Research, Education and Extension Organization and Research Institute of Forests and Rangelands

Abstract

Sainfoin (*Onobrychis sativa*) is an important fodder crop with good quality for livestock feeding. It is cultivated in both irrigation and dryland farming conditions. However, sainfoin powdery mildew disease, caused by the *Leveillula Taurica* fungus, can result in necrosis on the plant's leaf tissues and symptom spots. This severe condition can cause a decrease in plant growth, reduced size of the inflorescence, and a lower yield of forage. The most damage occurs during the second and third harvests. To breed improved sainfoin varieties tolerant to powdery mildew, a 12-year evaluation and selection process was carried out in three stages. This resulted in the release of two sainfoin varieties. Experiment 1 involved assessing powdery mildew resistance in 60 populations of sainfoin in response to powdery mildew. Out of these 60 populations, 19 were selected for both forage yield and powdery mildew tolerance or semi-tolerance. Experiment 2 involved assessing and seed production in some tolerant populations of sainfoin to powdery mildew. To identify tolerated and semi-tolerated populations for powdery mildew and their seed production, the seeds of 19 populations were sown in four research farms. All populations were evaluated for disease severity index (DSI) in natural conditions. Two populations, 3001 and 15353, were identified as tolerant populations in all four locations with DSI values of 12% and 23%, respectively. Seed propagation was made for both tolerant populations in an isolation farm. Experiment 3 involved sowing the seeds of two populations of 3001 and 15353 along with the native population susceptible to powdery mildew as a control in 10 farms. Data was collected for plant height and forage yield in three harvests in two years. The DSI of the two populations of 3001 and 15353 and the control was evaluated in the third harvest in both years. The two populations of 3001 and 15353 with DSI values lower than 10% coupled with higher yield were considered as tolerant to powdery mildew disease than to the native population with a DSI of higher than 50% in all locations. The quality of selected populations for crude protein and dry matter digestibility was assessed. Both varieties had higher quality than the local populations. Finally, the two populations were introduced as new cultivars for cultivation in both irrigation and dryland farming systems.



Research Work Title

Acquiring the Technical Knowledge of Ropak Catalyst Production Using Recovered Rhodium



Researcher | Seyed Mahmood Hashemi Hazaveh

Collaborators | Ali Ahmad Shokri, Tayebah Fatahi, Milad Aghamohammadi, Mahshid Bidhendi, Reza Mohammadi Hoseini, Dariush Sayadi

Collaborating Organizations | Petrochemical Research and Technology Company and Shazand Petrochemical Complex

Abstract

The Oxo Reactor Catalyst of 2EH plant (ROPAC), which is used in the petrochemical industry is a valuable and strategic catalyst. It is particularly used in the only 2EH Plant of Petrochemical Company in Iran, which produces raw materials for the plasticizers in the PVC polymer industry. This plant has a production capacity of 60,000 tons per year. Over the years, a significant amount of used catalyst containing the extremely precious rhodium metal has been accumulated by the plant. To recover the rhodium metal, various research projects have been conducted on laboratory and industrial scales, resulting in the successful development of the technical knowledge of rhodium metal recovery and production of the catalyst on an industrial scale. ROPAC meets the desired specifications of petrochemical industry by the standard of the 2EH plant and is used in the Oxo Industrial Reactor.



Research Work Title

Production of Ethylene Oxide Catalyst



Researcher | Marzieh Hamidzadeh

Collaborators | Maryam Alsadat Rahimifard, Morteza Nasirinia, Ali Akbar Norouzi, Zahra Eksiri, Alireza Alamshahi, Peyman Bigdeli

Collaborating Organization | Petrochemical Research and Technology Company

Abstract

Ethylene oxide is a crucial and extensively utilized petrochemical product, prompting numerous petrochemical companies worldwide to consider its production. The $Ag/\alpha Al_2O_3$ catalyst is employed in the partial oxidation process of ethylene-to-ethylene oxide in petrochemical plants. This catalyst, a supported heterogeneous catalyst, exhibits significant influence on catalytic performance through its physical and chemical properties, such as surface area, pore volume, and silver dispersion. Global production of ethylene oxide currently exceeds 12 million tons, with over half of it being utilized to produce ethylene glycol, a precursor to various polyester derivatives including fibres, bottles, and films. The production process began on a 12 kg scale in Mahshahr, with the catalyst being loaded and tested in industrial conditions within the reactor of an industrial unit. Subsequently, Poya Pajohesh Company oversaw the industrial-scale production of catalysts. Presently, the unit operates at a capacity of 750 kg per day, with potential for scaling up to 1 ton per day. The industrial production stages of ethylene oxide catalysts encompass initial support pre-treatment, washing, drying, and degassing of alpha alumina support to enhance absorption. This is followed by dry impregnation of the active ingredient on the base of alpha alumina and calcination, culminating in the packing of the catalyst.



Research Work Title

Grip Tank



Representative | Maziar Navahan Esmaeili

Collaborators | Hamidreza Zahir Emami, Alireza Zahir Emami

Collaborating Organization | Farapox Company

Abstract

When designing vertical and horizontal tanks, as well as atmospheric composite parts under internal pressure, it is crucial to ensure their strength and safety during both the design and operation phases. One common method to achieve this is by increasing the thickness of the shell, cap, and other components. However, if reinforcement sections are not utilised or used incorrectly in tanks, the desired strength may not be attained against all types of loads.

To tackle this issue, the use of FEM analysis can aid in the design of tanks and composite parts with both longitudinal and peripheral reinforcement sections inside and outside. This analysis helps identify high-risk areas in all parts of the tank, enabling the designers to determine the necessary number, location, arrangement type, and physical dimensions of the reinforcement sections required. By incorporating longitudinal and peripheral longitudinal reinforcement sections, the tank body and its components are interconnected, dividing the body into smaller segments and enhancing its resistance against external loads such as wind, earthquakes, and sudden shocks, as well as internal loads like hydrostatic pressure and internal pressure. As a result, stress distribution is improved throughout the tank body, reducing maximum stress ranges.



Research Work Title

An Antioxidant Mechanism and Phytochemical Analysis of Plants



Researcher | İlhami GÜLÇİN

Country | Republic of Türkiye

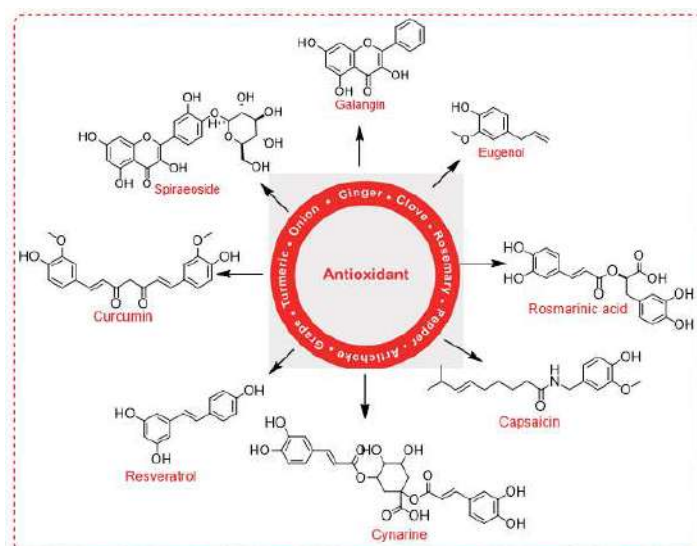
Field | Biochemistry

Scientific Affiliation | Ataturk University, Türkiye

Abstract

Professor İlhami GÜLÇİN's research has primarily focused on two key areas in the field of biochemistry. The first area of study involves exploring the antioxidant properties of various aromatic and medicinal plants, as well as phytochemicals and synthetic phenolic compounds. Through his investigations, he has identified and examined the antioxidant capacity of compounds such as caffeic acid, curcumin, resveratrol, and eugenol. These findings have garnered significant attention from the scientific community. The second aspect of Professor GÜLÇİN's work revolves around the purification, characterization, and inhibition properties of some metabolic enzymes associated with various global diseases. In pursuit of this, he has developed novel inhibitors for therapeutic purposes, with a particular purpose on carbonic anhydrase isoenzymes linked to conditions such as glaucoma, epilepsy, mountain sickness, stomach and duodenal ulcers, idiopathic intracranial hypertension, osteoporosis, and other neurological disorders. Additionally, Prof. GÜLÇİN's research has showcased the inhibitory effects of various inhibitors on acetylcholinesterase, butyrylcholinesterase, α -glycosidase, and α -amylase, as well as their potential in treating the aforementioned diseases.

Professor İlhami GÜLÇİN's extensive body of work, comprising 500 SCI-covered articles, has earned him the distinction of being a "Highly Cited Researcher" in 2014, 2015, and 2018, as recognized by Clarivate. Further, Professor GÜLÇİN is a distinguished member of the Turkish Academy of Sciences (TÜBA).



Research Work Title

The Synthesis, Chemical Properties and Application of Unique Compounds Containing Rare-Earth Elements, Lithium and Boron



Researcher | Thomas Schleid

Country | Federal Republic of Germany

Field | Mineral Chemistry

Scientific Affiliation | Stuttgart University, Germany

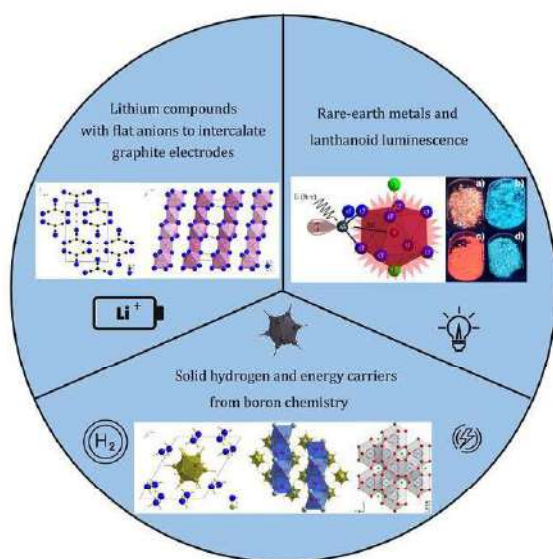
Abstract

Professor Thomas Schleid has successfully synthesized and characterized a total of 1035 new crystalline phases, consisting of 800 lanthanide, 100 boron, and 55 lithium compounds. These new compounds have a wide range of applications, including their use as ion conductors in batteries (such as sulfurized polypropylene as a cost-effective cathode material for high-capacity lithium-sulfur batteries and lithium thiocyanate), luminescent materials (like thallium hydroborate and Europium (II) Halide Oxoborates), and in hydrogen storage (such as ammonium and hydrazinium closo-hydroborates).

Part 1: Li⁺-cation conductors: Promising candidates: a) Lithium salts with soft complex anions, e.g. Li[CN], Li[OCN], Li[SCN], Li[N(CN)₂] and Li[C(CN)₃], all cigar-shaped or flat planar; b) Argyrodite-inspired ortho-thiophosphates(V) with participation of trivalent rare-earth metals, e.g. Li₃RE[PS₄]₂, Li₄RE[PS₄]₂Cl, Li₆RE₃[PS₄]₅ and Li₉RE₂[PS₄]₅.

Part 2: Heavy-metal phosphors: Ti₃Cl[B₁₂H₁₂]: Blue Ti⁺ lone-pair luminescence, EuHCl and Eu₅H₂O₂I₄: Ligand-dependent Eu²⁺ broad-band luminescence, almost ligand-independent Ln³⁺ line-luminescence (Ln = Eu or Tb) in bulk or doped samples containing hard fluoride and oxoanions, e.g. YF[SeO₃], Gd₃F[SeO₃]₄, Y₅F₃[AsO₃]₄, La₂F₂[As₂O₅] with lone-pair antennae or YF[MoO₄], YF[WO₄] and YF₂Mo₂O₇ with charge-transfer antennae.

Part 3: Solid-state hydrogen carriers: Ammonium and hydrazinium salts with hydro-closo-borate cage anions offer B–Hδ⁺⋯Hδ⁺–N dihydrogen bonds as preformed pathways for the irreversible release of elemental hydrogen (H₂): (NH₄)₂[BnHn], (NH₄)₃X[BnHn], (N₂H₅)₂[BnHn] and (N₂H₅)₂[BnHn] · 2 N₂H₄ with X = Cl – I and n = 10 and 12.



Professor Thomas Schleid has been an active member of multiple professional organizations, such as the German Crystallographic Association (DGK) and the German Chemical Society (GDCh) where he served as the chairman of the Crystal-Chemistry Section from 2010 to 2015 and the Chemical Education Section from 2012 to 2016. Currently, Professor Schleid is serving as the president for the German Crystallographic Association, a position he has held since 2021.

Research Work Title

Achieving sustainable development goals using multi-functional Nanomaterials



Researcher | Malek Maaza

Country of Residence | The Republic of South Africa

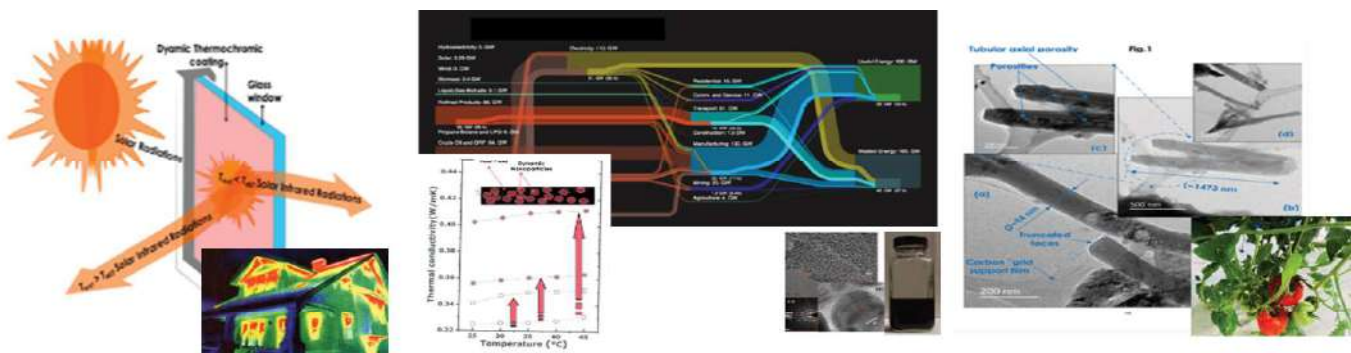
Field | Advanced Materials

Scientific Affiliation | University of South Africa, South Africa

Abstract

As of today, approximately 55% of the global population lives in urban areas. It is estimated by 2050, this number reaches around 2.5 billion, with about 90% of the increase occurring in Asia & Africa. With such a significant rise in urban population and the concurrent impact of climate change on seasonal atmospheric temperatures, there are several numerous challenges related to achieving Sustainable Development Goals. In this context, Science, Technology and Innovation (STI) as well as Research and Development (R&D) play a crucial role in addressing these challenges within the realms of energy, water, and health. In the energy sector, the utilization of Vanadium-based thermochromic nano-coatings holds great potential for smart window applications. These coatings effectively regulate solar heat radiation without requiring any additional energy input, thus enabling green air-conditioning. Likewise, the application of nano-fluids as advanced coolants can greatly contribute to waste heat recovery. In addition, recent research has demonstrated that carbon dioxide (CO₂) can be utilized to bio-engineer several multifunctional carbonates. These carbonates exhibit properties such as effective fertilization response and high reflectivity similar to radiative cooling paint, and significant porosity and hardness, making them a promising Supplementary Compound Material (SCM) for cement industry. The purpose of this study is to highlight on the above-mentioned properties and their interconnections.

Professor Malik Maaza is a co-founder of the African Laser Centre and South African Nanotechnology Initiative, which was established in 2001. He has played a leading role in initiatives such as the Nanosciences African Network, the African Materials Research Society, and the African Light Source. Since 2013, he has been a professor at the University of South Africa and associated with iThemba LABS since 2005, a renowned scientific research center also known as the National Accelerator Centre.



Research Work Title

The Development of Nanocarriers for Targeted Drug Delivery



Researcher | Muhammad Raza Shah

Country | The Islamic Republic of Pakistan

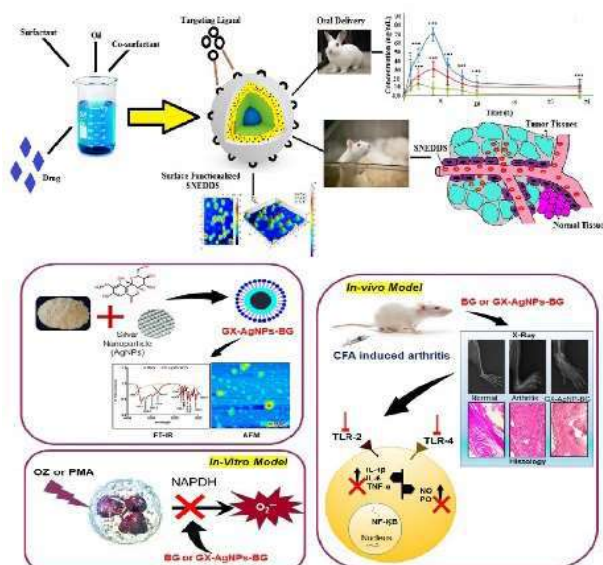
Field | Biocompatible Materials

Scientific Affiliation | International Centre for Chemical and Biological Sciences, Pakistan

Abstract

Professor Muhammad Raza Shah's area of study focuses on using biocompatible materials at the nanoscale for drug delivery purposes. The main aim is to improve the efficacy of therapeutic treatments and enhance biosensing capabilities. He actively involved in the development of nanocarriers specifically designed for targeted drug delivery. The ultimate objective is to reduce the side effects of active pharmaceutical ingredients throughout the treatment procedure. Professor Shah has achieved remarkable success in this field by utilizing various efficient nanocarriers such as polymeric nanocarriers, superparamagnetic nanoparticles, and lipid nanoparticles. Through these advancements, he has effectively utilized the size, shape, surface characteristics, and surface charge of custom-designed nanomedicines to enhance their efficacy and reverse resistance to drugs already available in the market. Additionally, Professor Shah has conducted extensive research on new drug candidates at the nanoscale to evaluate their therapeutic effectiveness and safety and published his research in various scientific journals. Furthermore, he has made significant contributions to the development of nano biosensors. These biosensors have proven instrumental in the molecular detection of biomarkers associated with disease diagnosis, reducing product contamination, and monitoring toxic analytes in blood samples.

Professor Muhammad Raza Shah has an impressive portfolio of over 460 research publications, showcasing his expertise and dedication to advancing the field of drug delivery using nanotechnology. In addition to his extensive research contributions, he has also been granted three patents in the United States for his innovative work. Professor Shah has extensive experience in conducting clinical trials. He has successfully managed 21 Phase-1 clinical trials (BE-PK) and served as the principal investigator for 05 phase-II clinical trials in the pharmaceutical filed. Additionally, he played a pivotal role in leading the Phase 1 clinical trial for the Sinopharm's company COVID-19 vaccine in Pakistan.





Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The Laureates of the the **2nd** Khwarizmi Innovation and Technology Award

Research Work Title

The Design and Manufacture of a 200 MW Synchronous Generator



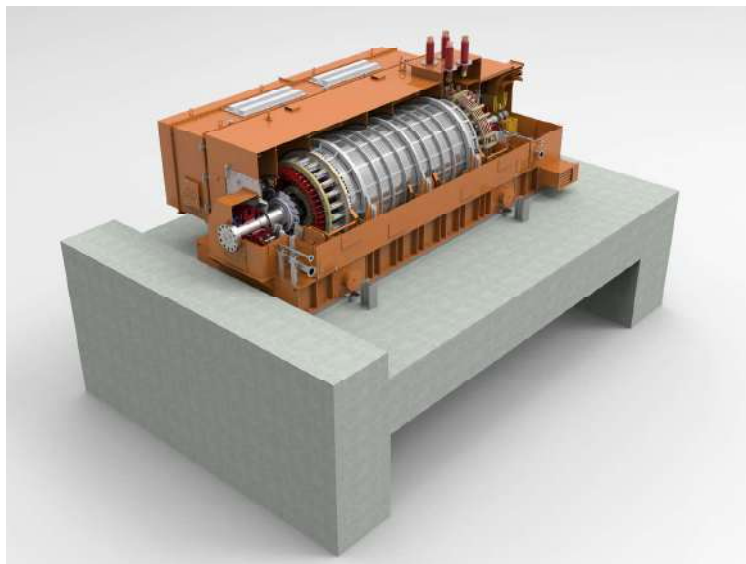
Representative | Hamed Kalantari

Collaborators | Mohammad Reza Shakeri, Ali Ashraf Kharamani, Sina Shahbazi, Ghasem Bazrafshan, Ali Ghaheri, Mohsen Nikfar, Farshad Kiani, Ehsan Mohammadian, Morteza Feyzbakhsh, Hadi Rangraz, Sirous Alavi, Mehdi Khadem

Collaborating Organization | MAPNA Generator and Wind Turbin Engineering and Manufacturing Company (PARS)

Abstract

A large synchronous generator with a nominal power of 200 MW has been designed and built which is capable of providing a large portion of the electricity needed by the power grid and plays a crucial role in supplying the required power. The design of synchronous generators involves many parameters which must be determined to achieve the optimal structure. The weight of the generator has a significant impact on its costs, so it has been designed with the minimum possible weight within this power range while maintaining maximum efficiency. The Pars Generator company has produced a 200 MW generator that is 10% lighter than those produced by competing companies in the world, but with the same efficiency. One of the unique features of this generator is its design based on the concept of modularity, which means it can be adjusted to output power higher or lower than 200 MW with the lowest possible cost. Various computing tools and software, mostly developed by the company's research and development department, have been used to optimize the weight and overall efficiency of the generator. This local design has been carried out using the capabilities of the human resources in the country.



Research Work Title

Technical Knowledge Acquisition, Design, and Manufacture of Coanda Burner



Researcher | Ayoub Adel Koudehi

Collaborating Organization | Sholeh Sanat Manufacturing and Engineering Company

Abstract

The project involves creating an ultra-low NO_x burner using multi-stage combustion technology based on the Coanda effect. This effect is when a fluid jet remains attached to a convex surface. The burner is designed to have high radiation heat transfer and ultra-low NO_x emissions. The project will include the design, and manufacturing of the burner as follows:

1. A valve has been separated in the gas path to detach 50% of the gas nozzles, resulting in an improved turn down ratio from 1/10 to 1/20. As a result, the burner's performance has been optimized, and stable and hard flames have been achieved in low fire.
2. The burner muffler has been modified to prevent uncontrolled air entry and to simplify the manufacturing process.
3. The muffler plate mechanism has been upgraded to reduce friction.
4. The burner's heat release range has been enhanced from 800,000 kcal/hr to 4,500,000 kcal/hr.





Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The Secretariat Report on Khwarizmi Awards

The Khwarizmi Awards “A Mirror Reflecting National Scientific Achievements”

The Khwarizmi Awards are a thoughtful approach to introducing the best national projects and recognizing outstanding scientists, researchers, innovators, and inventors who through their intellectual and practical knowledge and innovations, make today's world, with its ups and downs, brighter and more secure. These people of intellectual talent have excellent knowledge about the universe and its rules and develop scientific knowledge in many fields such as health, water management, agriculture, food resources, environment, engineering, communications, information, and the like for the betterment of their people and other nations.

The Secretariat of the Khwarizmi Awards treasures the records of projects submitted in each edition of the awards, the photos, videos, bulletins, rules and regulations, reports, and the hard and soft copies of the published documents. Today, this rich archive provides us with a valuable database that may allow the monitoring and observation of scientific development and research trends in different scientific fields over the last forty years in the country.

Considering the intellectual talents of more than 200 Iranian and foreign scientists residing in 50 countries in the world, it is realized that the Khwarizmi Awards would not only be a regular annual event, a ministerial policy, or just an international scientific event but they serve as proof of the competitiveness, and self-esteem of Iranian scholars and technologists and their constant efforts in leading the researchers and the youth to achieve sustainable development in the country. In the last 37 years, 98 bodies, as well as private and public, scientific and economic, and national and international organizations, joined the long list of sponsors of the Khwarizmi Awards, which is another proof of these awards' competitiveness and success.

The 37th Khwarizmi International Award

The Khwarizmi International Award (KIA) was founded, in 1987, after the victory of the Islamic Revolution of Iran. Today, this scientific contest is recognized as the longest-running annual scientific award that has been held successfully for four decades in the Islamic Republic of Iran.

Given that numerous scholars collaborated on a significant number of Khwarizmi-winning projects over the last four decades, it can be estimated that the community of KIA Laureates comprises several thousand members. This scientific community has excellent expert knowledge, perseverance, management skills, experience, creativity, and self-esteem, all considered valuable assets for accelerating scientific progress and developing new technologies in the country.

By examining the long list of KIA Laureates, and members of the Grand Jury and Scientific Committees, the experts across various scientific disciplines can discover numerous distinguished scientists listed. This serves as additional evidence of the Khwarizmi Awards' value creation, purposefulness, efficacy, and competitiveness.

The call for participation in the 37th KIA opened in the spring of 2023. The announcement was published on the KIA website and circulated worldwide in English, German, French, Arabic, Chinese, Russian, and Spanish. The deadline for participation in this call ended in the Fall of 2023. This award includes basic, applied, research and development, as well as innovation and technology research categories across all scientific fields other than human sciences at both national and international levels.

In this edition of the award, the KIA Secretariat received a total of 989 applications from both Iranian and foreign participants. Out of these, the Scientific Committees proposed 30 applications to the Grand Jury for further assessment. Having been responsible for the scientific, and technical evaluation of the projects as well as ranking the shortlisted ones, the Grand Jury has finally selected to award ten national and four international projects. The foreign KIA Laureates come from the Republic of Türkiye, the Federal Republic of Germany, the Republic of South Africa, and the Islamic Republic of Pakistan.

The Second Khwarizmi Innovation and Technology Award

Companies must embrace innovation in order to maintain their competitiveness and ensure long-term viability in global markets. In today's competitive global markets, Knowledge-driven enterprises are always facing challenges on their path to success, making innovation for technologists the key success.

Innovation plays a crucial role in developing and advancing existing technologies. To ensure continuous growth and competitiveness, it is imperative for small, medium, and large industries to adopt a scientific approach towards innovation, technology, and knowledge management.

This year, the second edition of the Khwarizmi Innovation and Technology Award was organized by the Iranian Research Organization for Science and Technology. In this edition, the received projects were carefully reviewed by the Scientific Committees. As a result, two projects were selected as the recipients of the Khwarizmi Innovation and Technology Award by the Grand Jury. One of the winning projects was proposed by the Scientific Committee of Mechanical Engineering, and the other by the Scientific Committee of Electrical and Computer Engineering.

Features of the Khwarizmi Awards

In this edition of the awards, in addition to all the necessary actions such as policymaking, strategic planning, effective implementation of procedures, careful monitoring of the Scientific Committees' performance, and upgrading and updating the electronic registration system, the directory of the Laureates of the Khwarizmi International Award and Khwarizmi Youth Award has been updated and finalized as well. This directory, named "Khwarizmi Kahroba Database", can be accessed at <https://Kia-kahroba.ir/laureates> and is searchable based on the project title, Laureate's name, keywords, subject area, year, and the award edition. The database, containing more than 2000 entries, serves as valuable resource for retrieving information about the former Khwarizmi Awards Laureates and their winning projects in Persian and English languages.

The Secretariat of Khwarizmi Awards would like to sincerely thank all participants, the many IROST colleagues who proudly serve at this event, the members of the Scientific Committees, the Grand Jury, and the Executive Committee who greatly contributed to the excellence and success of this award edition with their efforts, expertise, commitments and responsible follow-up.

The Permanent Secretariat
Khwarizmi Awards
February 2024

Laureates – The 37th Khwarizmi International Award

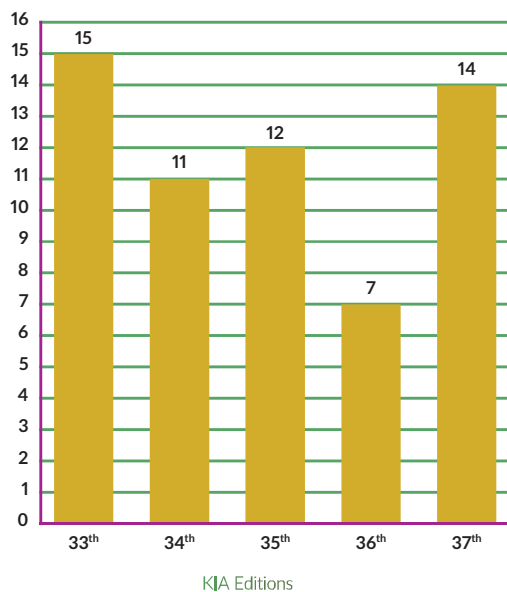
No.	Category	Scientific Committee	The First Place	The Second Place	The Third Place	Total
1	Research and Development	Chemical Technologies	--	1	1	2
		Mechanical Engineering	--	--	1	1
2	Applied Research	Water Management, Agriculture and Natural Resources	1	--	1	2
		Information and Communication Technology	--	1	--	1
3	Basic Research	Chemical Technologies	1	--	1	2
		Nanotechnology	Republic of South Africa		1	
		Chemical Technologies	Federal Republic of Germany		1	
		Biotechnology	Republic of Türkiye		1	
		Biotechnology	Islamic Republic of Pakistan		1	
Total						12

Laureates – The 2nd Khwarizmi Innovation and Technology Award

No.	Category	Scientific Committee	The First Place	The Second Place	The Third Place	Total
1	Innovation and Technology	Electrical & Computer Engineering	--	1	--	1
		Mechanical Engineering	--	--	1	1
Total			--	1	1	2

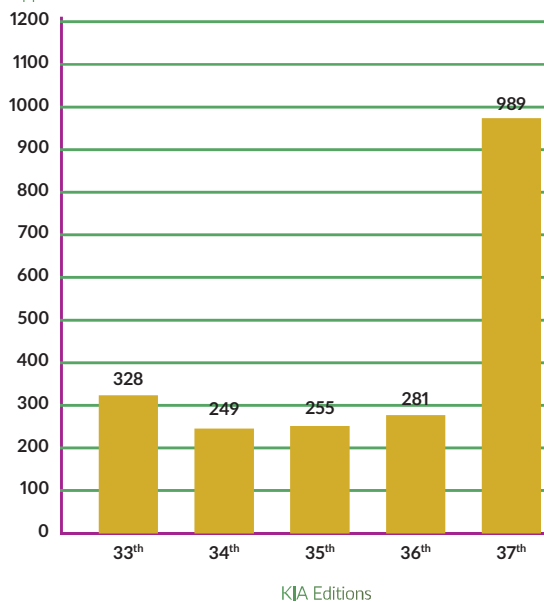
The total number of laureates during the last five editions of the Khwarizmi International Award

Number of Laureates



Total application entries during the last five editions of the Khwarizmi International Award

Application Entries



The Grand Jury Members

Prof. Zamanian, H.	Chairman of the 37 th Khwarizmi International Award
Dr. Shalmashi, A.	Executive Chairman of the 37 th Khwarizmi International Award
Prof. Hadadi Asl, V.	Amirkabir University of Technology
Dr. Vosoughi Vahdat, B.	Sharif University of Technology
Prof. Malek Ghorbanzadeh, A.	University of Tehran
Prof. Salehi, P.	Shahid Beheshti University
Prof. Zarasvandi, A.	Shahid Chamran University
Prof. Sadri Nasab, M.	University of Tehran
Prof. Khayam Nekoei, M.	Agricultural Research, Education and Extension Organization
Prof. Tayarani, M.	Iran University of Science and Technology
Prof. Abdkhodaie, M. J.	Sharif University of Technology
Prof. Mohannazadeh, F.	Iranian Research Organization for Science and Technology
Prof. Soudi, M.	Alzahra University
Dr. Ghezelayagh, M. H.	Imam Hossein University
Prof. Niknam, V.	University of Tehran
Prof. Matkan, A.	Shahid Beheshti University
Dr. Javanmard, M.	Iranian Research Organization for Science and Technology
Prof. Rezaee Far, O.	University of Semnan
Dr. Allahyari, A.	Iranian Research Organization for Science and Technology

The Scientific Committees

Arts, Architecture and Urban Planning	Head: Yeghaneh, M.
Basic Sciences	Head: Ragabi, M.
Biotechnology and Basic Medical Sciences	Head: Safavi, S.M.
Chemical Technologies/ Nanotechnology	Head: Kashi, I.
Civil Engineering	Head: Asgharian, B.
Electrical and Computer Engineering	Head: Amiri, S.
Innovation and Technology	Head: Salehirad, A.
Information and Communication Technology	Head: Nikaeen, A
Industrial Engineering and Technology Management	Head: Fllah Haghighi, N.
Materials, Metallurgy and New Energies	Head: Gholami Pour, R.
Mechanical Engineering/ Mechatronics/Aerospace	Head: Jabari, A.
Successful Laureates in National Production	Head: Allahyari, A.
Water Management, Agriculture and Natural Resources	Head: Zenozi, A.

Executive Committee Members

Zamanian, H.
Shalmash, A.
Sepahvand, R.
Fathi, H.
Ahmadi, H.
Mirzazadeh, M.
Rezaee, M.
Rahimi, Z.
Jask, F.
Shokri, Z.
Kheiri, F.
Vahedi, A.
Hosseini, H.
Namjoo, A.
Fasihi, R.
Safai, M.
Allahyari, A.

IROST Colleagues

Ranjbar, M.
Safavi, M.
Rajabi, M.
Aziz Mohseni, F.
Ariayi, H.
Javani, N.
Kazeminejad, N.

Quotes from the former Laureates of the Khwarizmi International Award



Dear Chairman,
I am delighted and honored to be the Laureate of the 36th Khwarizmi International Award in 2022. I wish to thank you warmly.

Prof. Jean-Laurent CASANOVA
Rockefeller University and the University of Paris; Laboratory of Human Genetics of Infectious Diseases, France



Dear Chairman,
Thank you to the Khwarizmi International Award committee and the jury members for bestowing upon me the prestigious 34th Khwarizmi International Award. I am honored and humbled to receive this international award from the jury. This award enormously enhances our cooperation with scientists in Iran in establishing the technology base for producing high-efficiency, large-area, all-printable perovskite solar cells, and their integration into photovoltaic modules for renewable energy applications.

Prof. Mohammad Khaja NAZEERUDDIN
École Polytechnique Fédérale de Lausanne (EPFL), Switzerland



Dear Chairman,
I have been granted many awards in my 40-year career as a distinguished professor of electrical engineering. However, KIA has a special place in my technical portfolio and is manifested as a significant recognition of my contributions to engineering and science, which I will cherish for the rest of my life.

Prof. Seyed Mohammad SHAHIDEPOUR
Illinois Institute of Technology, Iranian Resident in the U.S.A



Dear Chairman,
It is a great honor to become this year's KIA laureate. Science and technology can transcend cultures, languages, and borders. I am proud to be a member of the international KIA community. I hope that the award leads to scientific collaboration and exchange of students between Iran and Australia. Thank you, KIA organization.

Prof. Katharina GAUS
University of New South Wales, Sydney, Australia



Dear Chairman,
It is my great honor to receive the KIA Award. I believe KIA will be an important bridge between scientists in Iran and the world. I have a very close relationship with Iran. I have published collaborative research papers with Iranian scientists and professors. My products, mesoporous geolitic catalysts have been used in China petrochemicals engineering even in Iran's oil industry. In the future, I will do my best to promote the scientific collaborations between China and Iran.

Prof. Dongyuan ZHAO
Fudan University, The People's Republic of China



Ministry of Science, Research & Technology
Iranian Research Organization for
Science & Technology

The Sponsors of the Khwarizmi Awards and the Messages

International Sponsors

Logo	Title
	World Intellectual Property Organization (WIPO)
	Iranian National Commission for UNESCO
	Commission on Science and Technology for Sustainable Development in the South (COMSATS)
	Organization of Islamic Cooperation Standing Committee on Scientific and Technological Cooperation (COMSTECH)
	Economic Cooperation Organization (ECO)
	Asian and Pacific Centre for Transfer of Technology (APCTT)
	Scientific and Technological Research Council of Türkiye (Tübitak)
	Islamic World Educational, Scientific and Cultural Organization (ICESCO)
	World Association of Industrial and Technological Research Organization (WAITRO)

National Sponsors

	<p>Ministry of Science, Research & Technology (MSRT)</p>
	<p>National Elite Foundation</p>
	<p>International Park of Science and Technology of the Islamic republic of Iran</p>
	<p>Pardis Petrochemical Company</p>
	<p>Telecommunication Company of Iran</p>
	<p>Institute of Defense Industries for Education and Research</p>

The Prizes and Certificates of the Khwarizmi Awards

The Presidency of the I.R. Iran
Certificates



The Ministry of Science, Research
and Technology
Certificates



National Elite Foundation



Iranian Research Organization for
Science and Technology
The Khwarizmi Awards Trophy and
valuable cash prizes



**President of the Scientific and Technological
Research Council of Türkiye (TÜBİTAK)
World Association of Industrial and Technological
Research Organizations (WAITRO)
President's Message**



As the President of the Scientific and Technological Research Council of Türkiye (TÜBİTAK) and World Association of Industrial and Technological Research Organizations (WAITRO), it is a great pleasure to express our full support for the Khwarizmi International Award. We also acknowledge the Iranian Research Organization for Science and Technology for continuing the legacy of Muhammad ibn-Musa Khwarizmi with his great achievements in the basic sciences, particularly mathematics and astronomy. The Khwarizmi International Award plays an important role in recognizing outstanding scientific achievements and pursuing excellence in science and technology. The award symbolizes the spirit of innovation and pioneering ingenuity embodied by Muhammad ibn-Musa al-Khwarizmi during an era of scientific, economic, and cultural flourishing in this region. Al-Khwarizmi's contributions to algebra and algorithms represent an indelible mark in the scientific world and provide the basis for advances in technology development, inspiring generations of researchers and scholars up to the present times. In a similar respect, TÜBİTAK shares a vision for promoting leading scientific research and technological innovation to make an impact across society. We recognize the importance of fostering international cooperation and breakthroughs in science and technology. Our commitment to "co-creating and succeeding together" resonates with the challenges humanity currently faces. Solving complex, dynamic, and ever-changing challenges requires multi-disciplinary perspectives and collaborative efforts. Through WAITRO, we extend this approach towards being a sustainable innovation hub. By encouraging cross-border collaboration, WAITRO aims to collectively address global challenges and promote innovation – objectives that resonate with the aims of the Khwarizmi International Award. We believe that in our common strive to advance scientific knowledge and promote excellence in research and development, we will take the scientific community's collective pursuit for the benefit of humanity and the entire world forward. Advances in science and technology with a co-creation-based collaboration approach have the power to strengthen bonds between nations and address challenges. As the new Laureates are awarded at the 37th Khwarizmi International Award in 2024, we share our unwavering support for this prestigious occasion and congratulate the scientific talents that are entitled to this honour. We look forward to the continued success of this Award in its scope from aerospace and agriculture to the basic sciences, biotechnology, engineering, green technology, medical sciences, nanotechnology, and even technology management. We foresee that many more prominent scientists will be inspired by the pioneering legacy of Muhammad ibn-Musa al-Khwarizmi at a time when great achievements in science and technology are needed for a sustainable future.

Professor Hasan Mandal
President
TÜBİTAK and WAITRO

**Islamic World Educational, Scientific and Cultural
Organization (ICESCO)
Director General's Message**



At the 37th Khwarizmi International Awards, we celebrate the brilliance of minds that transcend boundaries and redefine the frontiers of human knowledge. These awards stand not just as accolades but as beacons illuminating the path of innovation, a tribute to the human spirit's relentless pursuit of understanding. In honouring outstanding achievements across diverse fields, from mathematics to medical sciences, we acknowledge the profound impact of the laureates' work on our global community. The legacy of Al-Khwarizmi lives on in laureates' ground-breaking contributions, a testament to the rich scientific heritage of the Islamic world. As Director General of the Islamic World Educational, Scientific, and Cultural Organization (ICESCO), I extend sincere congratulations to each laureate. Their dedication, perseverance, and intellectual curiosity inspire us all. May their endeavours continue to propel our collective journey toward a future where knowledge, collaboration, and innovation foster sustainable progress. Thanks for their exceptional contributions to the world of science. Their discoveries not only shape our presence but also guide the way for generations yet to come.

Dr. Salim M. AlMalik
Director General
ICESCO

World Intellectual Property Organization (WIPO) Director General's Message



On behalf of the World Intellectual Property Organization (WIPO), I would like to convey our warm congratulations to the laureates of the 37th Khwarizmi International Award (KIA) and the 25th Khwarizmi Youth Award (KYA). The discoveries and works of Muḥammad ibn Mūsā al-Khwārizmī have traversed the generations, serving as the basis for new ideas, scholarship and inventions that helped to transform the ancient world, and which continue to have a profound impact today. It is striking to think that his early works on algebra and algorithms – published almost twelve hundred years ago – form part of the building blocks behind the new digital age and the breathtaking advances promised by artificial intelligence (AI). As the United Nations agency for innovation and creativity, WIPO believes that intellectual property (IP) can and should be a powerful catalyst for economic growth and social development in all regions of the world, and indeed we are seeing more countries identify innovation, creativity, technology and digitalization as future growth drivers. This includes the Islamic Republic of Iran. Every year, WIPO publishes the Global Innovation Index (GII), which tracks and ranks the innovation performance of over 130 countries around the world. In the past 10 years, Iran has risen from 113th place in 2013, to 62nd place last year, ranking second amongst the economies of Central and South Asia. Recent years have also brought a rise in trademark applications, with Iranian filers making over 1.4 million applications between 2020 and 2022, a 20 percent increase on the three years prior. These are important achievements.

But IP registration is not an end in itself, instead it should be viewed as a means to an end, and a way of creating jobs, driving business growth and translating strong ideas into new products and services. In recent years, WIPO has supported local producers of pistachios, saffron and carpets to brand, market and package their goods through IP. We hope that such successes inspire others to see IP as part of their journey. This includes Iranian youth, who make up over 60 percent of the population. Ultimately, successful innovation ecosystems rest upon cultures that value innovation and creativity and that recognize and support scientific excellence and achievement. By inspiring more young minds to pursue a career in science and technology, the Khwarizmi Youth Award plays a crucial role in nurturing such an outlook and bringing innovation and creativity to all. Thus, it is our pleasure to offer warm congratulations to all this year's winners, as well as those who participated in the awards. As you seek to build upon the enduring legacy Muḥammad ibn Mūsā al-Khwārizmī, we wish you every success in your endeavors.

Daren Tang
Director General
WIPO

**Asian and Pacific Centre for Transfer of
Technology (APCTT) of the
United Nations Economic and Social Commission
for Asia and the Pacific (ESCAP)
Head's Message**



It is an honour and privilege for me to convey this message on the occasion of the 37th Khwarizmi International Award ceremony. I congratulate all the laureates of this prestigious international award. Undoubtedly, the award is a recognition of their remarkable contributions and achievements in the fields of science, technology and innovation.

As the world is striving to achieve the Sustainable Development Goals, innovations and technologies are invaluable for the progress of humankind and protection of environment. The Award is a reinforcement of the importance of science, technology and innovation as a means to achieve sustainable development in the face of critical development challenges, such as climate change, energy and food security, water scarcity and climate-induced disasters. These challenges provide a range of opportunities for scientists and technologists to develop and apply innovative and inclusive solutions for socio-economic growth and environmental benefits.

It is heartening to learn that the Awardees are from different countries across the world, including from the Asia-Pacific region. This offers opportunities for scientists and innovators to forge cross-border collaboration in further research and development, scale up, and diffusion of innovative technologies. By sharing knowledge and experience, and working collaboratively, the transformative potential of innovative technologies could be harnessed for a better future that is sustainable and climate resilient. Towards this endeavour, the Asian and Pacific Centre for Transfer of Technology of ESCAP offers a useful collaborative platform to facilitate multistakeholder engagements for technology cooperation and transfer across the region. Together, we can make a difference and pave the way for a greener and more resilient future.

Once again, I convey my best wishes and warm congratulations to this year's KIA winners and the organizers who have put in their hard work and commendable efforts to a great success.

Preeti Soni
Head
APCTT-ESCAP

Commission on Science and Technology for Sustainable Development in the South (COMSATS) Executive Director's Message



COMSATS congratulates and appreciates its esteemed Centre of Excellence in Iran, the Iranian Research Organization for Science and Technology (IROST) for organizing the 37th Khwarizmi International Award (KIA), to honour outstanding scientists and researchers for their significant contributions towards science, technology and innovation (ST&I). The organization of this prestigious Award since 2000 signifies the important role IROST is playing in benefiting from the valuable resource and expertise of scientists, researchers and innovators to bring about constructive change in the society by providing S&T-based solutions to address the global challenges. My heartiest congratulations to the winners of this year's KIA award on their well-deserved distinction.

Undoubtedly, Science, Technology, and Innovation have consistently proven to be the panacea for humanity. Their impact has been far reaching for the socio-economic development. In today's rapidly evolving world, R&D driven ST&I stand as the bedrock of progress and the key to unlocking solutions for pressing global challenges.

The empowerment of young scientists and innovators plays a pivotal role in fostering sustainable socio-economic development. Recognizing and celebrating their contributions, the Khwarizmi International Award stands as a commendable initiative. This award acknowledges and supports the outstanding work of scientists and researchers, contributing to the fruitful advancement of knowledge and innovative solutions.

The National Poet of Pakistan, Dr. Allama Muhammad Iqbal, emphasized the potential of Youth often referring to them as Eagles. A poignant line from his verses reads:

Your resting places are not the minarets of the royal palaces.

You are an Eagle, the rocks of the mountains should be your habitat.

Young scientists and researchers should aspire to dream big, search for knowledge, and challenge the status quo. The potential for utilization of science and technology knows no bounds. Undoubtedly, the future's potential hinges on the diligent efforts and perseverance of today's young scientists.

Technology has transformed the world into a global village and hence made the collective approach to tackle common issues practicable and effective. To view the problems through a shared lens and come up with solutions that are supported by science and technology and accepted by all, there need to be a cross border cooperation, and partnerships that may improve resource usability, and enhance knowledge generation. COMSATS, being an international/intergovernmental organization is endeavouring to unite developing countries for judicious use of science and technology.

Having 27 Member States and a Network of 25 renowned International Science and Technology Centres of Excellence, COMSATS has been striving to promote South-South and Triangular cooperation through facilitating capacity building; collaborative research and development; and sharing of knowledge, experiences, good practices and technological resources among the member countries. R&D Centres and their sustainability is important, which will come with alignment with the industrial sector. COMSATS has recently ventured into a series of new initiatives in the fields such as Artificial Intelligence based Data Analytics, Genome Sequencing, IT Trainings, Precision Agriculture, Renewable Energy, Electric Vehicles, Tech-enabled Health Units, Drone Technology, and the forward march is on.

COMSATS recognizes the contributions of its esteemed Centers in placing science and technology at the forefront of development initiatives within its member nations. It is noteworthy to highlight IROST's commendable efforts in advancing S&T-driven development in Iran and across other member countries.

Ambassador Dr. Mohammad Nafees Zakaria
Executive Director
COMSATS

Economic Cooperation Organization (ECO) Secretary General's Message



Reiterating my reflection on the Khwarizmi International Award (KIA) is an immense privilege and the matter of great honour for me.

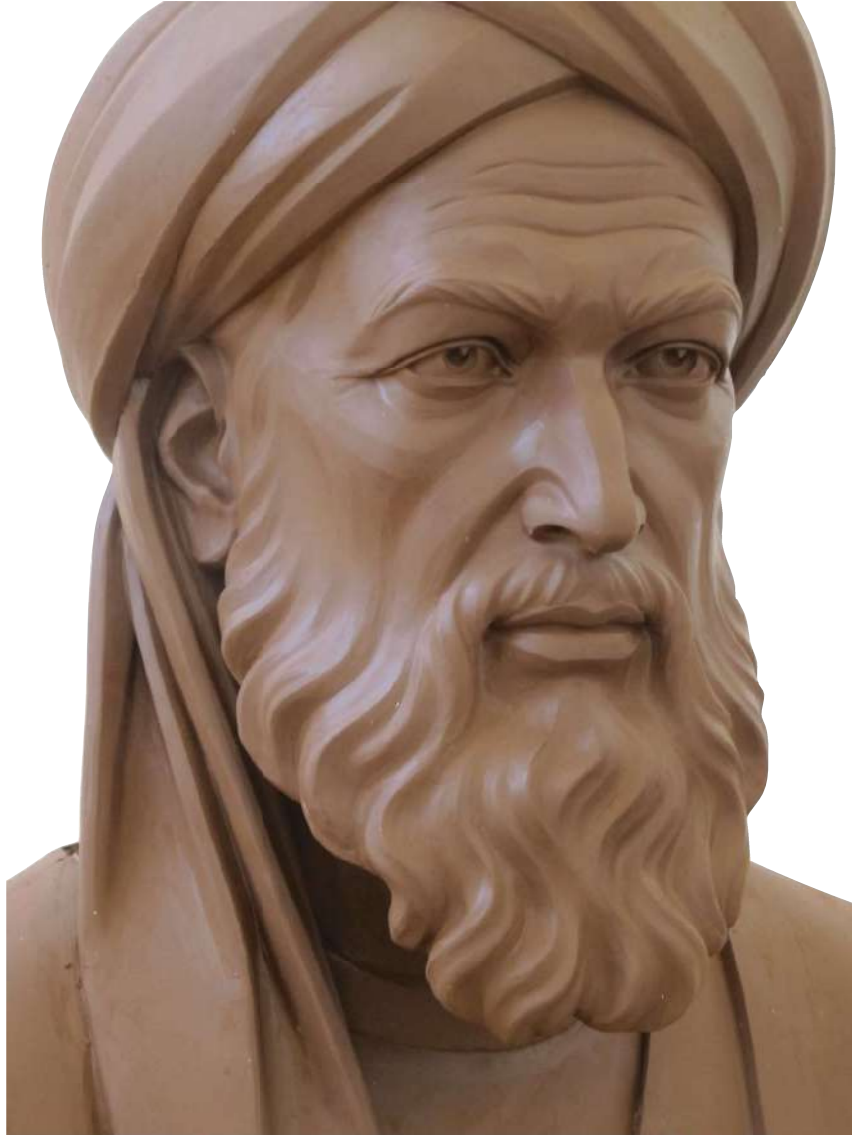
The KIA is important, not only to acknowledge the contribution of researchers and scientists, but also to stimulate the spirit of scientific education amongst our youth. The KIA bears very attractive and heartening approach while playing a substantial role in the global promotion of science and technology.

The Economic Cooperation Organization (ECO) places the cultural and scientific cooperation on top of its regional development agenda. In this context, the Organization appreciates various science-friendly initiatives of the Islamic Republic of Iran, most prominently the annual presentation of KIA to the outstanding individuals who have rendered invaluable services for the development of science and technology.

Having this opportunity, I would like to thank and felicitate the Government of the Islamic Republic of Iran for regularly organizing the KIA's event.

Khusrav Noziri
ECO Secretary General

The Biography of Muhammad ibn Musa Khwarizmi



Muhammad ibn Musa Khwarizmi was a Persian Muslim mathematician, astronomer, astrologer and geographer. He was born in Persia of that time and died around 850. Historians have different interpretations on his life and the origin of his name Khwarizmi. He studied and wrote many books and treatises. His Algebra was the first book on the systematic solution of linear and quadratic equations. Consequently Khwarizmi is to be considered to be the father of algebra. His contributions not only made a great impact on mathematics, but on language as well. The word algebra is derived from al-abr, one of the two operations used to solve quadratic equations, as described in his book. The words algorism and algorithm stem from algoritmi, the Latinization of his name.



Contributions

His major contributions to mathematics, astronomy, astrology, geography and cartography provided foundations for later and even more widespread innovation in algebra, trigonometry, and his other areas of interest. His systematic and logical approach to solving linear and quadratic equations gave shape to the discipline of algebra, a word that is derived from the name of his book on the subject named “The Compendious Book on Calculation by Completion and Balancing”. This book was first translated into Latin in the twelfth century.

His book on the Calculation with Hindu Numerals was principally responsible for the diffusion of the Indian system of numeration in the Middle-East and then Europe. This book also translated into Latin in the twelfth century, as *Algoritmi de numero Indorum*. From the name of the author, rendered in Latin as *algoritmi*, originated the term algorithm. Khwarizmi systematized and corrected Ptolemy's data in geography as regards to Africa and the Middle east. Another major book was his *Kitab surat al-ard* (“The Image of the Earth”; translated as Geography).

He also assisted in the construction of a world map for the caliph al-Ma'mun and participated in a project to determine the circumference of the Earth, supervising the work of 70 geographers to create the map of the then “known world”. When his work was copied and transferred to Europe through Latin translations, it had a profound impact on the advancement of basic mathematics in Europe. He also wrote on mechanical devices like the astrolabe and sundial.

Algebra

Kitab al-mukhtar fi hisab al-jabr wa-l-muqabala “The Compendious Book on Calculation by Completion and Balancing” is a mathematical book written approximately 830 CE.

Arithmetic

Khwarizmi's second major work was on the subject of arithmetic, which survived in a Latin translation but was lost in the original Arabic.

Geography

Khwarizmi's third major work is his *Kitab surat al-Ard* “Book on the appearance of the Earth”. It is a revised and completed version of Ptolemy's Geography, consisting of a list of 2402 coordinates of cities and other geographical features following a general introduction.

Astronomy

Khwarizmi's *Zij al-sindhind* (astronomical tables) is a work consisting of approximately 37 chapters on calendrical and astronomical calculations and 116 tables with calendrical, astronomical and astrological data, as well as a table of sine values. This is one of many Arabic zijes based on the Indian astronomical methods known as the *sindhind*.

Jewish calendar

Khwarizmi wrote several other works including a treatise on the Hebrew calendar. It describes the -19 year intercalation cycle, the rules for determining on what day of the week the first day of the month Tishri shall fall; calculates the interval between the Jewish era (creation of Adam) and the Seleucid era; and gives rules for determining the mean longitude of the sun and the moon using the Jewish calendar. Similar material is found in the works of Biruni and Maimonides.