ASSOCIATION OF CHEMISTRY TEACHERS

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Promoting Excellence in Chemistry Education

Association of Chemistry Teachers
News Letter, May - August 2024

Contents of the News Letter : Issue - 29

From Editorial Desk

Prof. Wasudeo Gurnule
Editor
Kamla Nehru Mahavidyalaya,
Nagpur, Maharashtra.

We are happy to inform that the contributions of ACT ranges from International Olympiads, National and International Conferences, organizing seminars, Science exhibitions, Workshops, expert invited talks, Innovating conceptual science experiments, Talent search examinations, training faculty and students etc. We are bringing in the present issue of the newsletter with the reports on the ACT activities, trends in Chemistry, views and news. We have included one scientific article in the present issue. We have also included reports on National Chemistry Events. We humbly request the entire fraternity of ACT to continue to contribute both in terms of their academic and individual achievements for the benefit of entire ACT Community.

We invite good suggestions and better contributions from the readers to get best output of the future issues. We welcome you all to participate in the NCCT 2024.

With warm regards to one and all

Members of Editorial Board

Honorary Members of ACT

We have great pleasure in bringing the updated list of honorary members of Association of Chemistry Teachers, who are sources of inspiration, guidance and support in activities of ACT.

The editorial board of ACT News Letter is proud of the academic achievements of these legendary honorary members.

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Reports of Activities of ACT

Workshop on Learning Life Sciences through Experiments

Workshop on Learning Life Sciences through Experiments for school and junior college teachers organized by Bombay Association for Science Education (BASE) on August 17, 2024 at Wilson College Mumbai.

Prof. D. V. Prabhu addressing the gathering

Paticipants of the workshops

Participants performing the experiments

ACT ACTIVITIES DURING MAY-AUGUST 2024

1) One Day Seminar on Green Clean Earth on June 5, 2024 at Department of Biochemistry, University of Lucknow, Lucknow by Dr. D. K. Awasthi, Retired Head, Department of Chemistry, J. N. M. PG College, Lucknow and Prof. Shraddha Sinha, Retired Head, Department of Chemistry, B. B. Das NIIT, Lucknow.

2) International Conference on Nanochemistry and Theragnostics (Hybrid mode) on July 29-30, 2024 by Dr. Sanjay Kumar Chowdhary and Prof. Prem Mohan Mishra at Department of Chemistry, LNM University, Darbhanga, Bihar.

3) Five Day Online Faculty Development Programme on Advancements in Materials Science Research on July 29 to August 2, 2024 by Dr. V. S. Angulakshmi at PG and Research Department of Chemistry, PSGR Krishnammal College for Women, Coimbatore, TamilNadu.

4) One week Training Workshop on Good Laboratory Practices and Safety Measures on August 14-22, 2024 at Department of Chemistry, Integral University, Lucknow in collaboration with Borosil Scientific Ltd. Prof. Sudha Jain was the resource person and Prof. Shraddha Sinha was the Guest of Honour on the occasion.

5) Conference : A Conventional Discussion on Synthetic Organic Chemistry and Beyond on August 27-28, 2024 at Government Madhav Science PG College, Ujjain, MP by Prof. Kalpana Singh and Prof. Brijesh Pare.

BOOKS PUBLISHED BY ACT MEMBERS

1. Essence of Spectroscopy by **Dr. Damodar V. Prabhu**, **Dr. Prabodh Chobe, Dr. Ajit Datar and Dr. Harichandra A. Parbat,** 2024 Iterative Internationa Publishers(IIP), Michigan, USA and India.

2. Basic Concepts of Chemical Kinetics by **Dr. Damodar V. Prabhu**, **Dr. Harichandra A. Parbat** and **Dr. Venkat S. Narayan**, 2024, Iterative International Publishers (IIP), Michigan, USA and India.

3. Hydrogen : The Eco-friendly Future Fuel (Hindi version) by **Dr. Mannam Krishna Murthy** and **Dr. Prem Mohan Mishra** published by Interactive International Publishers (IIP), USA & India

# Biomass for Future Resource of Fuel and Platform Chemicals

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The rapid population growth of India and the urge for a high living standard led to an increased demand for energy consumption in India. Currently, the major energy dependence is based on thermal power plants. However, this resource has resulted in serious environmental impacts, such as high CO_2, SO_x and NO_x emission. Moreover, the depletion of fossil fuels possess a significant threat to future generations. To achieve sustainable social, economic, and environmental growth, it is essential to explore other renewable energy sources. Wind, solar and hydropower share only an insignificant part of global energy consumption as the climatic conditions restricts the further scaling up of the technology [1].
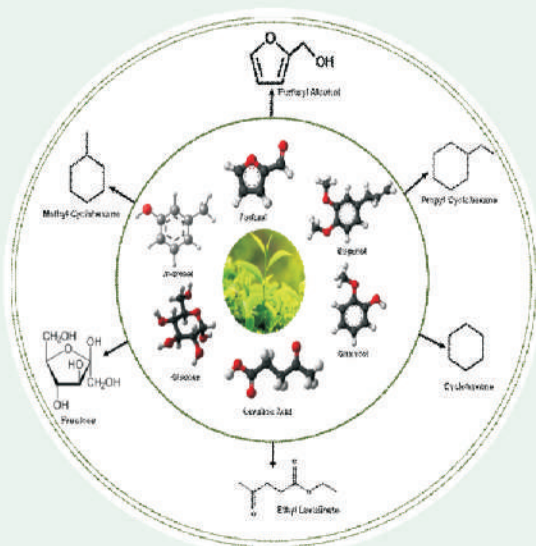
Scheme 1
Conversion of different biomass model components to value added chemicals.

In this scenario, biomass can be considered as a sustainable source of energy as it is eco-friendly and replenishable. Plants or plant-based materials (lignocellulosic biomass) are the major feedstock for meeting the future energy requirements. Analogous to the petrochemical industry, biomass valorization can be achieved through various technologies. Based on the unique structures of different biomass components, various products such as biofuel, biodiesel, platform molecules and fine chemicals can be generated (Scheme 1). Lignocellulosic biomass consists of cellulose (35-50%), hemicellulose (25-30%) and lignin (15-30%). Sugar, starch and oil crops are first-generation biomass feedstock derived from cellulose and hemicellulose, which can be hydrolyzed to get glucose and other monosaccharides. These C5 and C6 hydrolyzed products can be further hydrogenated to generate the corresponding alcohols that are used as biofuels. Fatty acids, another natural source of biofuel derived from plants, algae, and tallow, can also be selectively deoxygenated or decarboxylated to produce diesel-range alkanes [2].
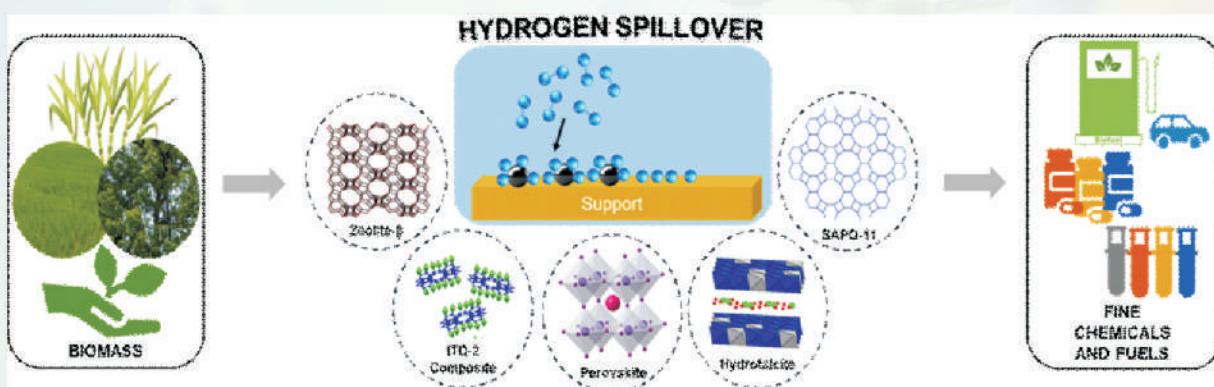
Scheme 2 *Different catalyst design for biomass valorization.*

Lignin is an under-utilized agricultural waste (second-generation biomass feedstock) among lignocellulosic biomass. It is a polyphenolic substance comprising the polymeric products of *p*-coumaryl, coniferyl, and sinapyl alcohols. In the first stage of processing, lignin is depolymerized into phenolic components such as eugenol, guaiacols, syringols, cresols, and phenols. The lignin-derived phenolic compounds have a high oxygen content, making them unsuitable for use as transportation fuels. This problem can be addressed by upgrading through hydrotreating (hydrogenation/deoxygenation, decarboxylation, hydrodeoxygenation, etc.), an emerging and challenging strategy in heterogeneous catalysis [3].

The well-known industrial hydrodesulfurization catalysts, viz, CoMoS and NiMoS, were employed for the hydrodeoxygenation of lignin-derived molecules. Despite its high efficiency, sulfur released during the processes deactivates the active sites of the catalyst. Noble metals such as Pd, Pt, Ru and Rh and other non-noble transition metals (Fe and Ni) are well known for hydrotreating reactions due to their hydrogen spillover property and oxophilic nature [4]. The key factor determining the efficiency of heterogeneous catalysts is the presence of stable, accessible and uniformly distributed active species, which should not suffer from deactivation during the process. The conversion route and detailed mechanism for the transformation of biomass model systems (e.g., m-cresol, anisole, levulinic acid, iso-eugenol) can be explored using different catalyst designs (porous, layered, structured oxide) and various textural properties (surface acidity, basicity, redox properties) (Scheme 2). This article discusses the application of diverse heterogeneous catalysts for the conversion of various biomass model components.

Zeolites are well acclaimed for possessing a uniform channel, high surface area, flexible porosity, good chemical and hydrothermal stability, tunable Brönsted acidity, and redox properties. The incorporation of noble (Pt, Pd, Ru) and non-noble (Ni, Fe, Co) metals and metal oxides into various zeolite support (zeolite-β, MCM-22, ITQ-2) makes them multi-functional materials for various organic transformation reactions. *m*-cresol is a well-known lignin-derived phenolics model compound. The hydrotreating of *m*-cresol yields cyclic hydrocarbons and their derivative molecules, which depend on the nature of the catalyst. For example, 5 wt% ruthenium-loaded zeolite-β (large pore and strong acidic nature) is efficient for hydrotreating *m*-cresol to yield a completely hydrogenated product [5]. The moderate acidic catalyst, viz., ruthenium-incorporated SAPO-11, hydrogenates *m*-cresol, completely yielding ring hydrogenated product, methyl cyclohexanol and methyl cyclohexanone [6]. The increase in surface acidity and the redox properties of metallic ruthenium on the surface contribute to the hydrogenation of *m*-cresol via a hydrogen spillover process [6]. Further, a noble metal-free approach for hydrotreating lignin-

based aromatic compounds was explored. Nickel-oxy-hydroxide decorated ITQ-2 (delaminated zeolite) composite exhibited efficient activity for the hydrodeoxygenation (HDO) of *m*-cresol exclusively to methylcyclohexane. It is manifested by the catalyst's increased accessibility to active sites due to the exfoliated layers and improved acid redox properties [7]. Apart from hydrotreating, other conversion routes, viz., esterification and oxidation, can emerge value-added chemicals. Hetero ions (Al^{3+}, Ga^{3+}, Ti^{4+}, and Zn^{2+}) incorporated into zeolite-β showed excellent activity for the esterification of levulinic acid using several alcohols (such as methanol, *n*-butanol, and amyl alcohol) to levulinate esters [8]. Cerium-containing MCM-22 zeolites (medium pore zeolite with external pockets) facilitate a good conversion of *iso*-eugenol with the selective formation of vanillin, which is an important flavouring agent [9]. Similar activity was witnessed for molybdenum carbonyl incorporated on amine-functionalized MCM-22 in the oxidation of *iso*-eugenol [10]. The fine-tuning of acidic sites and metal dispersion on zeolite framework is responsible for executing different hydrotreating processes and selectively producing value-added chemicals, fuel and fuel additives.

Mixed metal oxides derived from structured inorganic molecules, like hydrotalcites and perovskites, can also act as suitable supports and active centers for various biomass model component transformations. Ruthenium-containing nickel hydrotalcite (NiRu-HT)-type materials are found to be efficient hydrotreating catalysts for eugenol, which is an essential biomass-derived molecule. Eugenol was initially hydrogenated to 4-propyl guaiacol, followed by concurrent demethoxylation and aromatic ring hydrogenation, resulting in the formation of 4-propylcyclohexanol [11]. Mixed metal oxide derived from nickel-ruthenium hydrotalcite prepared by facile water-free solid-state grinding method were highly efficient and reusable catalysts for the hydrotreatment of anisole. The presence of *in-situ* generated metallic nickel–ruthenium species on the surface of the catalyst facilitates the conversion of biomass model components in these catalytic systems [12]. The magnesium aluminium hydrotalcite having bimetallic nickel-ruthenium (1.3% Ni and 0.74% Ru) species shows complete functional group hydrogenation of cinnamaldehyde with 97.5% selectivity to hydrocinnamyl alcohol [13]. A catalytic system comprising 15 wt% nickel and 2 wt% ruthenium was investigated for its efficacy in the selective reduction of furfural to furfuryl alcohol [14]. Nickel and ruthenium co-doped $SrFeO_{3-\delta}$ ($SrFe_{0.9}Ni_{0.05}Ru_{0.05}O_{3-\delta}$) perovskite also exhibit better catalytic performance in the hydrogenation of furfural to furfuryl alcohol with a selectivity of 91%. Homogenous dispersion of exsolved Ni–Ru alloy from oxygen-deficient perovskite support facilitates the hydrogen spillover mechanism and hence the noticeable selectivity to hydrogenated product [15].

Mono- and bimetallic non-noble metal-based catalyst systems have been employed in upgrading biomass processes. Molybdenum species in higher oxidation states can facilitate reactions such as hydrogenation and oxidation due to their high affinity for olefinic groups. A molybdate-intercalated magnesium iron hydrotalcite exhibited significant activity for the esterification of biomass-derived levulinic acid. The resulting material showed a 93% conversion of levulinic acid to butyl levulinate. These products are known to be excellent fuel additives as well as used in the flavoring and fragrance industries [16]. Molybdate-incorporated hydrotalcite-type α-$Ni(OH)_2$ shows a significant conversion for the anisole hydrotreating in vapour phase conditions, yielding a steady-state conversion of 30% with benzene as the primary product and methyl anisole, methylcyclohexane, and toluene, as minor components. The same catalyst system was demonstrated to be promising for the oxidation of *iso*-eugenol to vanillin [17].

Table 1 Biomass model component conversion reactions using various heterogeneous catalysts

Sl. No.	Catalysts	Reaction type	Catalytic activity					Ref
			Substrate	Reaction condition	Con. (%)	Major Product (Sel. (%))		
1	Ru/β Zeolite	HDO	m-Cresol	170 □, 1 MPa (H_2), 8 h	100	Methyl cyclohexane (100)		5
2	Ru/SAPO-11	HDO	m-Cresol	160 □, 1 MPa (H_2), 6 h	100	Methyl cyclohexanone (55)		6
3	Ni-ITQ-2 Composite	HDO	m-Cresol	170 □, 2 MPa (H_2), 6 h	99	Methyl cyclohexane (100)		7
4	Hetero ions [AP□, Ga²□, Ti□□, and Zn²□) incorporated into zeolite-β	Esterification	Levulinic acid	Alcohol reflux condition, 5 h	>95*	Levulinate ester		8
5	Ce- MCM-22	Oxidation	iso-eugenol	60 °C, 1.5 h	63	Vanillin (75)		9
6	Molybdenum Carbonyl Grafted on Amine-Functionalized MCM-22	Oxidation	iso-eugenol	70 °C, <2 h	87	Vanillin (61)		10
7	NiRu- HT	HDO	Eugenol	150 °C, 2.5 MPa (H_2), 6 h	100	4-propylcyclohexanol		11
8	Ni-Ru HT	HDO	Anisole		100	Cyclohexane (86)		12
9	Ni-Ru containing Mg/Al HT	Hydrogenation	Cinnamaldehyde	150 □,1 MPa H_2, 10 h	100	Hydrocinnamyl alcohol (97.5)		13
10	Ruthenium promoted Ni-Mg–Al HT	Hydrogenation	Furfural	150 □,1 MPa H_2, 6 h	100	Furfurylalcohol (86)		14
11	Reduced SrFe₀.₉Ni₀.₀₅Ru₀.₀₅O₃₋δ	Hydrogenation	Furfural	160 □,1 MPa H_2, 6 h	99	Furfurylalcohol(91)		15

*Yield of levulinate ester

Sr. No.	Catalysts	Reaction type	Catalytic activity				Ref
			Substrate	Reaction condition	Con. (%)	Major Product (Sel. (%))	
12	Molybdate intercalated Mg-Fe HT	Esterification	Levulinic acid	120 °C, 4 h	93	butyl levulinate (95)	16
13	Molybdate-incorporated α-Ni(OH)₂	HDO	Anisole	450 °C, H_2 atm WHSV=1.5 h⁻¹	30	Benzene (63.5)	17
14	Molybdate-intercalated Mg- Fe HT	Oxidation	iso-eugenol	80 °C, 5 h	86.2	Vanillin (83.1)	18
15	SrFe₀.₇₅Mo₀.₀₅O₃₋δ	Oxidation	iso-eugenol	60 °C, 1.5 h	73	Vanillin (63)	19
16	Ru/Ni-Fe HT	HDO	Anisole	190 ?, 2 MPa (H_2), 6 h	98	Toluene (99.8)	20
17	Ru/α-Ni(OH)₂	HDO	Anisole	175 °C, 2 MPa (H_2), 6h	90	Toluene (49)	21
18	Mesoporous nickel oxide	Hydrogenation	Furfural	150 ?,2 MPa H_2, 5 h	73	Furfurylalcohol(90)	22
19	Mg–Al–Mo HT	Oxidation	Cinnamyl alcohol	110 °C and 6 h	82	Epoxy cinnamyl alcohol (73)	23
20	Ru/α-Ni(OH)₂	Oxidation	Cinnamyl alcohol	90 °C and 6 h	84	Cinnamaldehyde (80)	21
21	Molybdate-incorporated α-Ni(OH)₂	Oxidation	iso-eugenol	100 °C, 5 h	76.1	Vanillin (75.5)	17

Molybdate-intercalated magnesium-iron hydrotalcite materials demonstrated effective conversion of iso-eugenol to vanillin under solvent-free conditions [18]. Similarly, oxidation of iso-eugenol to vanillin was achieved using iron-based perovskite (SrFe₀.₇₅Mo₀.₂ ₅O₃ -δ) [19]. The representative results of various biomass model component conversion reactions over different catalysts are summarized in Table 1. The structural and textural properties of various catalyst designs are crucial for the selective formation of valuable chemicals and fuel additives from biomass.

In summary, inorganic-porous, layered, and structured bulk mixed metal oxides are poised to become the future materials for catalysts and catalytic supports in biomass valorization, thereby promoting sustainable growth in our society.

The Nobel Prize in Chemistry 2024

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Chemistry 2024 with one half to and the other half jointly to

David Baker
University of Washington, Seattle, WA, USA

Demis Hassabis
Google DeepMind, London, UK

John M. Jumper
Google DeepMind, London, UK

They cracked the code for proteins'amazing structures

The Nobel Prize in Chemistry 2024 is about proteins, life's ingenious chemical tools. David Baker has succeeded with the almost impossible feat of building entirely new kinds of proteins. Demis Hassabis and John Jumper have developed an AI model to solve a 50-year-old problem: predicting proteins' complex structures. These discoveries hold enormous potential.

The diversity of life testifies to proteins' amazing capacity as chemical tools. They control and drive all the chemical reactions that together are the basis of life. Proteins also function as hormones, signal substances, antibodies and the building blocks of different tissues.

"One of the discoveries being recognised this year concerns the construction of spectacular proteins. The other is about fulfilling a 50-year-old dream: predicting protein structures from their amino acid sequences. Both of these discoveries open up vast possibilities," says Heiner Linke, Chair of the Nobel Committee for Chemistry.

Proteins generally consist of 20 different amino acids, which can be described as life's building blocks. In 2003, **David Baker** succeeded in using these blocks to design a new protein that was unlike any other protein. Since then, his research group has produced one imaginative protein creation after another, including proteins that can be used as pharmaceuticals, vaccines, nanomaterials and tiny sensors.

The second discovery concerns the prediction of prot in long strings that fold up to make a three-dimensional structure, which is decisive for the protein's function. Since the 1970s, researchers had tried to predict protein structures from amino acid sequences, but this was notoriously difficult. However, four years ago, there was a stunning break through.ein structures. In proteins, amino acids are linked together .

In 2020, **Demis Hassabis** and **John Jumper** presented an AI model called AlphaFold2. With its help, they have been able to predict the structure of virtually all the 200 million proteins that researchers have identified. Since their breakthrough, AlphaFold2 has been used by more than two million people from 190 countries. Among a myriad of scientific applications, researchers can now better understand antibiotic resistance and create images of enzymes that can decompose plastic.

Life could not exist without proteins. That we can now predict protein structures and design our own proteins confers the greatest benefit to humankind.

They have revealed proteins' secrets through computing and artificial intelligence

Chemists have long dreamed of fully understanding and mastering the chemical tools of life – proteins. This dream is now within reach. Demis Hassabis and John M. Jumper have successfully utilised artificial intelligence to predict the structure of almost all known proteins. David Baker has learned how to master life's building blocks and create entirely new proteins. The potential of their discoveries is enormous.

How is the exuberant chemistry of life possible? The answer to this question is the existence of proteins, which can be described as brilliant chemical tools. They are generally built from 20 amino acids that can be combined in endless ways. Using the information stored in DNA as a blueprint, the amino acids are linked together in our cells to form long strings.

Then the magic of proteins happens: the string of amino acids twists and folds into a distinct – sometimes unique – three-dimensional structure (Figure 1). This structure is what gives proteins their function. Some become chemical building blocks that can create muscles, horns or feathers, while others may become hormones or antibodies. Many of them form enzymes, which drive life's chemical reactions with astounding precision. The proteins that sit on the surfaces of cells are also important, and function as communication channels between the cell and its surroundings.

It is hardly possible to overstate the potential encompassed by life's chemical building blocks, these 20 amino acids. The Nobel Prize in Chemistry 2024 is about understanding and mastering them at an entirely new level. One half of the prize goes to Demis Hassabis and John Jumper, who have utilised artificial intelligence to successfully solve a problem that chemists wrestled with for over 50 years: predicting the three-dimensional structure of a protein from a sequence of amino acids. This has allowed them to predict the structure of almost all 200 million known proteins. The other half 2(9) of the prize is awarded to David Baker. He has developed computerised methods for achieving what many people believed was impossible: creating proteins that did not previously exist and which, in many cases, have entirely new functions.

The Nobel Prize in Chemistry 2024 recognises two different discoveries but, as you will see, they are closely linked. To understand the challenges this year's laureates have overcome, we must look back to the dawn of modern biochemistry.

The first grainy pictures of proteins

Chemists have known since the nineteenth century that proteins are important for life's processes, but it took until the 1950s for chemical tools to be precise enough for researchers to start exploring proteins in more detail. Cambridge researchers John Kendrew and Max Perutz made a groundbreaking discovery when, at the end of the decade, they successfully used a method called X-ray crystallography to present the first three-dimensional models of proteins. In recognition of this discovery, they were awarded the Nobel Prize in Chemistry in 1962.
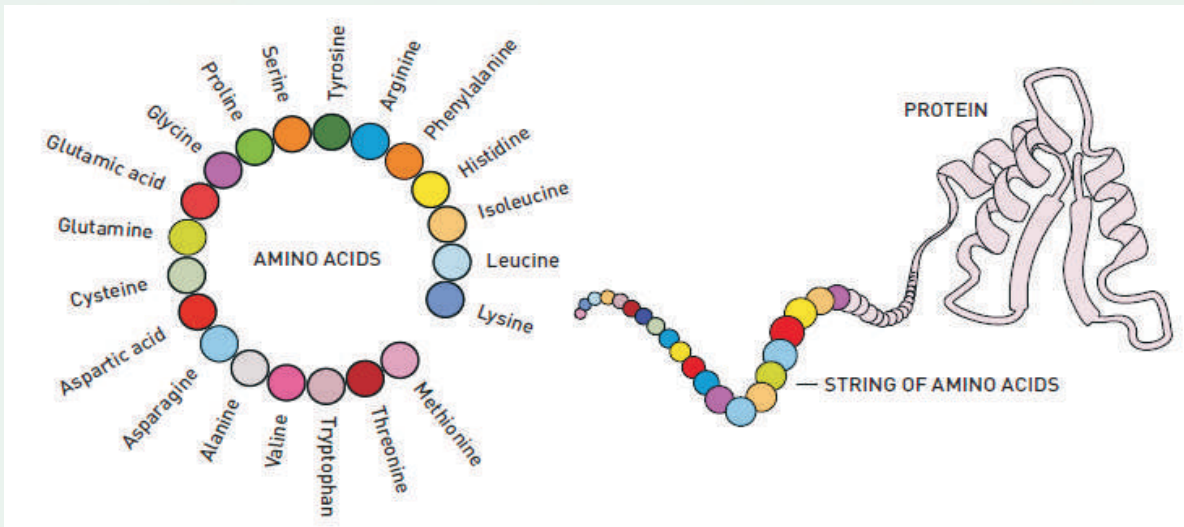

Figure 1. *A protein can consist of everything from tens of amino acids to several thousand. The string of amino acids folds into a three-dimensional structure that is decisive for the protein's function.*

Subsequently, researchers have primarily used X-ray crystallography – and often a great deal of effort – to successfully produce images of around 200,000 different proteins, which laid the foundation for the Nobel Prize in Chemistry 2024.

A riddle: how does a protein find its unique structure?

Christian Anfinsen, an American scientist, made another early discovery. Using various chemical tricks, he managed to make an existing protein unfold and then fold itself up again. The interesting observation was that the protein assumed exactly the same shape every time. In 1961, he concluded that a protein's three-dimensional structure is entirely governed by the sequence of amino acids in the protein. This led to him being awarded the Nobel Prize in Chemistry in 1972.

However, Anfinsen's logic contains a paradox, which another American, Cyrus Levinthal, pointed out in 1969. He calculated that even if a protein only consists of 100 amino acids, in theory the protein can assume at least 10^{47} different three-dimensional structures. If the chain of amino acids were to fold randomly, it would take longer than the age of the universe to find the correct protein structure. In a cell, it just takes a few milliseconds. So how does the string of amino acids actually fold?

Magnetic Fields Supercharge Hydrogen Peroxide Production

New catalyst achieves 90% efficiency in hydrogen peroxide production, enhancing safety and environmental sustainability.

Scientists have made a significant advancement in enhancing the efficiency of an electrochemical reaction used to produce hydrogen peroxide, a crucial chemical in disinfection, bleaching, and sewage treatment. The reaction, called the the oxygen reduction reaction (ORR), was improved by developing a new class of heterogeneous molecular catalysts with an integrated magnetic field. Traditional hydrogen peroxide production methods pose several challenges; they are energy-intensive, and the concentrated product is difficult to transport safely. To address these issues, the research team looked towards an electrochemical method that is more efficient and environmentally friendly.

Innovative Catalyst Design

The research team designed a novel catalyst by anchoring cobalt phthalocyanine (CoPc) molecules on carbon black (CB) and then integrating them with polymer-protected magnetic (Mag) nanoparticles. This unique structure enables effective spin state manipulation of the cobalt active sites, significantly enhancing catalytic performance.

The researchers discovered the CoPc/CB-Mag catalyst achieved a remarkable H_2O_2 production efficiency of 90% and significantly enhanced the reaction's efficiency. Notably, the catalyst requires only minimal amounts of magnetic materials – up to seven orders of magnitude less than previous approaches – making it both safer and more practical for large-scale applications.

Magnetic Enhancement of Catalytic Processes

"Our integrated magnetic field approach can shift the cobalt center from low-spin to high-spin state without modifying its atomic structure," said Di Zhang of the Advanced Institute for Materials Research (WPI-AIMR), "This spin transition dramatically improves the catalyst's intrinsic activities in both oxygen reduction and evolution reactions."

To understand the fundamental mechanism behind this new catalyst, they used a technique called comprehensive density functional theory (DFT) calculations. Understanding why and how it works is important for future studies. "We found that the high-spin Co site exhibits stronger binding with oxygen-containing intermediates, which is crucial for efficient catalysis," explained Associate Professor Hao Li, "The magnetic field-induced spin polarization also facilitates electron transfer and spin transitions during the reaction steps, boosting the catalytic kinetics."

"The combination of experimental results and theoretical insights provides a comprehensive picture of how magnetic fields can enhance catalytic performance," added Li, "This can serve as guidance when designing new catalysts in the future."

Implications for Sustainable Industrial Practices

The findings could lead to the rational design of catalytic active materials, targeting for more efficient and environmentally friendly pathways to produce hydrogen peroxide and other value-added chemicals, contributing to global efforts in sustainable industrial processes and carbon-neutral energy technologies.
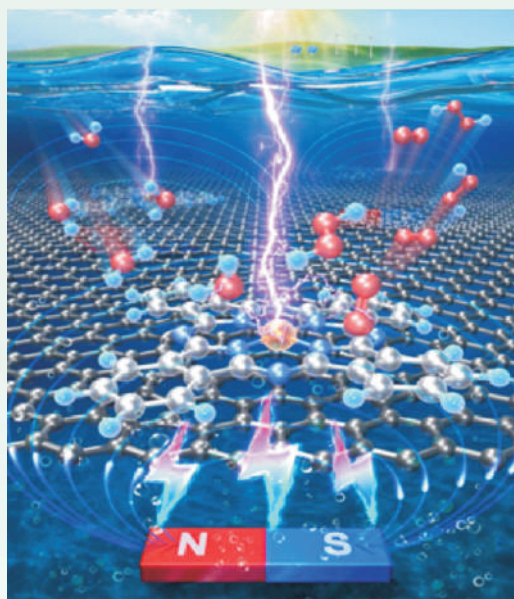
List of ACT Life Members During May' 2024 to Aug' 2024

Sr. No.	Names	LM No.	Institution
1	Dr. Premansh Dudhe	2611	S. N. Govt P. G. College, Khandwa - 450001
2	Dr. Sunil Kumar Patidar	2612	S. N. Govt. P.G. College, Khandwa, (M.P.)- 450001
3	Parvinder Khanuja	2613	S. N. Govt. P.G. College, Khandwa, (M.P.)- 450001
4	Dr. Meena Salve	2614	S. N. Govt. P.G. College, Khandwa, (M.P.)- 450001
5	Dr. Indubala Singh	2615	Dept. of Chemistry, S. N. Govt. P.G. College, Khandwa, (M.P.) - 450001
6	Dr. Vidya Singh	2616	Department of Chemistry, Maharana Pratap Govt. P.G. College, Hardoi, U.P. - 241001
7	D.B.N. Suresh Varma	2617	Shri Vishnu Engineering College for wormen, Bhimavarma, W. G. Dist, Andra Pradesh - 534202
8	Dr. Priyanka Tyagi	2618	Dept. of Chemistry, Dhanauri PG College, Haridwar (UttaraKhand) - 244667
9	Josyula Sesha Sailaja	2619	SITAM Engineering Collage, Gajularega, Vizianagaram, (A.P.) - 535002
10	Swaroopa Rani N. Gupta	2620	Dr.Ms. S. N. Gupta, Professor, Chemistry Dept., Brijlal Biyani Science Collage, Amravati - 444605
11	Prof. Ved Prakash Singh	2621	Department of Chemistry, School of Physical Sciences, Mizoram University, Aizawl, Mizoram - 796004
12	Prof. Keshav Lalit Ameta	2622	Dept. of Applied Chemistry, School of Applied Material Science Central University of Gujarat, Tal. Dabhoi, Dist. Vadodara, Kundhela (Gujarat) - 391107 (INDIA)
13	Upasana Bora Sinha	2623	Dept. of Chemistry, Nagaland University - 798627

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16	Dr. Vinita Kapoor	2626	Sri Venkateshwara,College, University of Delhi, South Campus, Delhi - 110021
17	Prof. B. B. V. Sailaja	2627	Dept. of Chemistry, Andra University, Vishakhapatnam, Andra Pradesh - 530003
18	Pradhyuman Singh Ranawat	2628	Department of Chemistry, University of Science, MLSU, Udaipur - 313001
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