

Celebrating the Career and Scientific Legacy of Prof. C. N. R. Rao

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This special issue of *Chemistry of Materials* celebrates the remarkable career and enduring legacy of Prof. C. N. R. Rao, a pioneering figure in solid-state and materials chemistry. As Prof. Rao celebrated his 90th birthday on June 30, 2024, we take this opportunity to reflect on his immense contributions to science and his profound impact on the global scientific community. His relentless pursuit of knowledge, coupled with his commitment to mentoring young scientists, has shaped the field of materials chemistry for over seven decades.

Prof. C. N. R. Rao's scientific journey is a testament to his dedication and brilliance. Over seven decades, he has authored over 1800 publications and more than 56 books, covering various topics from spectroscopy and solid-state chemistry to nanomaterials and 2D materials like graphene. His early work in spectroscopic methods, including infrared and UV–visible spectroscopy, laid the groundwork for his future explorations in solid-state chemistry—a field then in its infancy.

During the 1960s, 70s, and 80s, Prof. Rao's pioneering research on defects and defect ordering in oxides, pressure-induced phase transitions in halides, metal–insulator transitions, and ferroelectricity established him as a leading figure. His interest in transition metal oxides, particularly those with perovskite structures, significantly influenced the understanding and development of these materials.

Prof. Rao's work on high-temperature superconductivity is particularly noteworthy. His early studies on layered perovskites like La_2CuO_4 and La_2NiO_4 predated the discovery of high-temperature superconductivity by Bednorz and Müller. When high T_c superconductivity burst onto the scene in the late 1980s, Prof. Rao's earlier research proved critical in understanding these phases' crystal chemistry, magnetism, and doping-induced metal–insulator transitions. His group in Bangalore was among the first to synthesize and characterize $\text{YBa}_2\text{Cu}_3\text{O}_7$ with a T_c of approximately 90 K. Similarly, his studies on colossal magnetoresistance in manganese-containing perovskites were pivotal in advancing the field.

In recent years, Prof. Rao has significantly contributed to studying metal–organic frameworks (MOFs) and low-dimensional materials such as graphene, MoS_2 , fullerenes, carbon nanotubes, and various types of nanowires. His research on these topics has been groundbreaking, opening new avenues for exploration and application in materials science.

Prof. Rao's influence extends far beyond his research. His dedication to mentoring has directly impacted hundreds of young researchers and inspired thousands more globally. He has been instrumental in shaping the careers of numerous scientists through his mentorship and guidance. He created an

environment where regular conferences were held in different parts of the country, which allowed young students to intermingle with top personalities in the fields of chemistry and physics of materials. Prof. Rao's commitment to fostering scientific research and education in India is evident in his efforts to improve funding, facilities, and opportunities for young scientists.

Prof. Rao has also been a key figure in establishing and leading scientific institutions into positions of excellence. Much of the global prominence enjoyed by the Department of Chemistry at the Indian Institute of Technology Kanpur during the 1960s and 70s was built with significant help from his internationally acclaimed research contributions in diverse areas of chemistry and his vision of nurturing a world-class chemistry department. He then moved to the Indian Institute of Science (IISc) to establish the first academic center in India devoted entirely to Solid State and Structural Chemistry in 1976. He served as the Director of IISc from 1984 to 1994, transforming the institution with the influx of young talents, the development of extensive critical infrastructure, and research funding. As its founding President, he established the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) in Bengaluru in 1989. JNCASR has emerged as one of India's premier research institutions under his guidance. He was President of this institution until 1999 and continues to work there as Linus Pauling Professor and Honorary President. One of the leading research areas at JNCASR is the chemistry and physics of materials, a subject close to Prof. Rao's heart. Beyond the confines of institutions, his vision and leadership have been crucial in promoting nationally and internationally interdisciplinary research and collaboration. Prof. Rao has also played a critical role in fostering international collaborations among Indian scientists. His efforts have led to numerous joint research projects and academic exchanges with institutions worldwide, fostering a global network of scientific cooperation. This has been a recurring theme in the countless prestigious conferences and symposiums around the world where he has been invited to speak; his keynote addresses often highlight the

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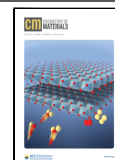




Figure 1. President Pranab Mukherjee conferred Prof. C.N.R. Rao with India's highest civilian honor, Bharat Ratna, in Rashtrapati Bhavan on February 4, 2014.

importance of interdisciplinary research and the need for sustained investment in science and technology.

Prof. Rao's contributions extend to his instrumental role in nurturing and sustaining the research ecosystem in India via extensive participation in policy-making. As a member and chair of various national and international scientific advisory committees, he has influenced science policy and funding decisions that have had long-term benefits for scientific research and development in India and globally. Beginning with his involvement in the science advisory committee to the Prime Minister of India during Mrs. Indira Gandhi's tenure, he later chaired this committee for many years. His advocacy and efforts secured significant investments from the Indian Government to enhance research facilities across numerous institutions in India, including smaller ones; a prominent example of this is the establishment of NanoMission under his leadership by the Ministry of Science and Technology, Government of India. Due to his visionary efforts over many decades, India's scientific contribution has steadily increased, particularly in the areas broadly under the chemistry and physics of materials. He contributed significantly to conceptualizing the new system of undergraduate science education in India, translating the concepts into reality by establishing several Indian Institutes of Science Education and Research (IISERs) spread across the country. He was also instrumental in establishing the only national institution devoted to nanoscience and technology, namely the Institute of Nano Science and Technology (INST), Mohali. His work has elevated India's position in the global scientific community and

inspired a culture of excellence and innovation in Indian science.

Prof. Rao's contributions have been recognized with numerous prestigious awards, including the Bharat Ratna, India's highest civilian award, in 2014 (Figure 1). He holds honorary degrees from over 85 universities worldwide. He is a member of several esteemed scientific academies, including the Royal Society (London), the U.S. National Academy of Sciences, and the French Academy of Sciences. His accolades include the Hughes Medal, the Royal Medal of the Royal Society, the Dan David Prize, the Eni Award's Energy Frontiers prize (Figure 2), and the August-Wilhelm-von-Hoffmann Medal of the German Chemical Society. Prof. Rao has also been honored with the von Hippel Award, the highest recognition of the Materials Research Society (MRS).

Prof. Rao's passion for science and education has also led him to advocate for better educational facilities for young students, particularly in rural areas. He has been a strong proponent of improving undergraduate education in science and has emphasized the need for better funding and laboratories to support research. Through the CNR Rao Foundation, established with his wife, Mrs. Indumati Rao, he has worked to excite young minds about science and nurture future generations of scientists. Prof. Rao's ability to communicate complex scientific concepts in an accessible manner has inspired many to pursue careers in science.

As we celebrate Prof. C. N. R. Rao's 90th birthday and extraordinary career, we acknowledge his profound impact on materials chemistry and the scientific community. His

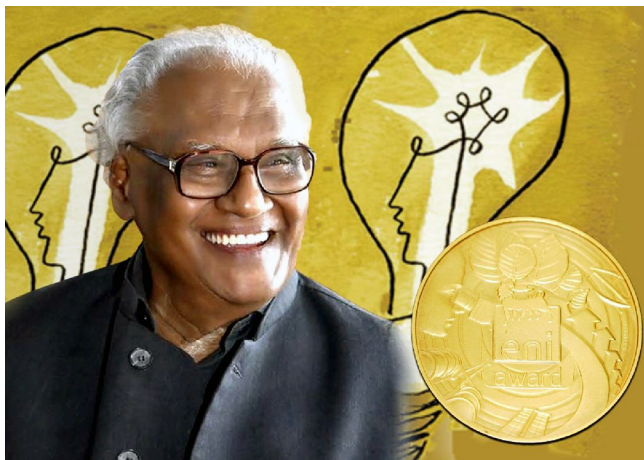


Figure 2. Prof. Rao received the Eni Award's Energy Frontiers prize in 2021

relentless pursuit of excellence, mentorship, and visionary leadership have left an indelible mark on science. We express our deepest gratitude for his contributions and look forward to the continued influence of his work on future generations of scientists.

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Notes

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