The Impact of My Published Work

Over the course of my career at KFUPM, I have established myself as one of the most influential scientists in laser spectroscopy, environmental diagnostics, advanced nanomaterials, photocatalysis, renewable energy systems, and sustainable technologies which is evidenced by my scholarly output, comprising more than 742 publications, including over 509 ISI-indexed journal articles, 21 book chapters, and a specialized monograph with Springer, has earned more than 19,470 citations and an h-index of 72. According to global metrics, I am consistently ranked among the Top 10 Laser Physics Scientists worldwide, within the Top 2% of scientists globally as reported by the Stanford University database, and recognized by Google Scholar as #9 in lasers, #2 in photocatalysis, #1 in clean water and renewable energy, and #2 in oil-water separation research. These indicators reflect not only my sustained productivity but also the profound influence my research has exerted across multiple scientific domains.

My work has significantly shaped the evolution of modern laser-based analytical science. My research in laser-induced breakdown spectroscopy (LIBS), laser-induced fluorescence (LIF), photoacoustic spectroscopy (PAS), optogalvanic spectroscopy, LIDAR, and laser-enhanced ionization helped establish fundamental principles, models, and instrumentation that are now widely used globally. Through my pioneering work in calibration-free LIBS, dual-pulse enhancement, chemometric-assisted quantitative diagnostics, and real-time elemental analysis, I helped transform laser spectroscopy from a primarily academic tool into a practical, field-deployable technology for environmental monitoring, industrial diagnostics, and biomedical applications. My contributions have enabled the rapid detection of toxic metals, hazardous gases, industrial emissions, desalination brine constituents, pharmaceuticals, geological materials, biological tissues, and atmospheric pollutants tools that support national industries, environmental agencies, and research centers worldwide.

A significant area of impact lies in environmental protection and sustainability, where my research has provided innovative technological solutions to pressing national and global challenges. I developed advanced laser-based sensing platforms for water quality monitoring, atmospheric pollution analysis, hazardous waste detection, petrochemical emissions tracking, and real-time monitoring of contaminated soils and industrial by-products. These systems have proven essential for environmental agencies and industries that require rapid, accurate, and non-destructive diagnostic tools. Moreover, my contributions to photocatalytic degradation of pollutants, visible-light-driven processes, solar hydrogen production, and CO_2 conversion into value-added chemicals have become widely cited references, helping shape emerging research directions in environmental chemistry, materials science, and renewable energy.

In the field of advanced nanomaterials and clean energy, my research in pulsed laser ablation in liquid (PLAL) has been globally recognized as a transformative method for producing high-purity, defect-engineered nanomaterials. These materials have enabled breakthroughs in photocatalysis, electrocatalysis, solar cells, hydrogen evolution reactions, supercapacitors, and next-generation photodetectors. My work in designing nanostructured materials such as spinels, perovskites, MXenes, graphene-based composites, and transition-metal oxides has provided new insights into charge transfer, oxygen vacancies, interface engineering, and catalytic mechanisms. These developments have contributed substantially to global efforts focused on green hydrogen production, cost-effective energy storage, and sustainable materials engineering.

Another dimension of the impact of my published work lies in innovation and intellectual property creation. I am among Saudi Arabia’s most prolific inventors with over 75 U.S. patents granted or published and 16 additional patents under review. These patents cover hydrogen production systems, photocatalytic reactors, novel membranes for water purification, environmental sensors, optical diagnostic systems, supercapacitors, fuel desulfurization technologies, and advanced catalysts. Many of these patented technologies have direct industrial relevance and commercialization potential, contributing to Saudi Arabia’s technological advancement and supporting Vision 2030 priorities.

My published work is also recognized through numerous prestigious awards, including the Almarai Innovation Award, the HRH Prince Mohammed Bin Fahd Award for Excellence in Research, the Donald Julius Groen Prize (IMechE, UK), multiple Best Project Awards (KACST, SABIC, DSR), Best Paper Award (Bahrain), and Distinguished Researcher Awards from KFUPM in 2006, 2011, and 2016. I also received High Impact Paper Awards for two ISI-indexed publications in 2022. These honors reflect the societal and industrial relevance of my scientific contributions.

My global scientific engagement further amplifies the impact of my published work. I serve on the editorial boards of 10 ISI-listed journals, frequently deliver invited keynote lectures, and collaborate with world-leading institutions such as MIT, Nanjing University, National University of Singapore, and several European universities. My participation in the 1981 Lindau Nobel Laureate Meeting and my international research partnerships underscore the global reach and lasting significance of my work. In recognition of my contributions to science, education, and community service to KSA, I was honored with Saudi citizenship by His Majesty King Salman bin Abdulaziz.

My Scientific Contributions to the Publications

My scientific contributions span conceptual innovation, experimental leadership, instrument design, data interpretation, and high-impact scientific writing across several interconnected fields. As the senior or corresponding author on the majority of my publications, I have directed the scientific vision from the identification of research problems to the synthesis and communication of results.

In the early stages of my career, I laid the foundation for high-resolution laser diagnostic technologies, developing fundamental approaches in laser magnetic resonance spectroscopy, LIBS, LIF, PAS, and related optical diagnostics. I designed new optical geometries, optimized plasma-laser interactions, and established theoretical models that were later adopted internationally as the basis for calibration-free and enhanced LIBS methodologies. My publications demonstrated how laser-matter interactions could be engineered to yield precise quantitative elemental signatures across geology, environmental analysis, biomedicine, agriculture, and industrial monitoring.

A defining feature of my contributions is the translation of advanced laser spectroscopy into real-world analytical tools. I led the development of portable, field-ready LIBS systems for detecting toxic metals in food, water, cosmetics, pharmaceuticals, herbal medicines, biological tissues, soils, and airborne particulate matter. I designed customized experimental setups, implemented plasma optimization strategies, and built chemometric frameworks for robust quantitative diagnostics. In each of these studies, I personally oversaw calibration procedures, validation using reference analytical techniques, and the development of data-acquisition and processing pipelines that ensured scientific reliability.

My contributions to photocatalysis, renewable energy, and nanotechnology are similarly significant. I was among the earliest researchers to introduce laser-synthesized nanomaterials including metal oxides, perovskites, bismuth oxyhalides, and doped carbon nitride systems as high-performance catalysts for environmental remediation and energy conversion. I formulated the hypotheses behind defect engineering, bandgap tuning, and heterojunction formation. I led the synthesis protocols, directed the detailed structural and optical characterization, and interpreted mechanistic studies using electrochemical, spectroscopic, and computational tools. These publications provided the community with new pathways for designing materials for CO_2 conversion, wastewater purification, and solar-assisted hydrogen production.

In the area of energy storage, I pioneered the design of high-performance supercapacitor electrodes, hydrogen evolution catalysts, and perovskite-based photodetectors. My contributions included developing doping strategies, forming hybrid nanocomposites, designing interface engineering techniques, and building electrochemical testing workflows. My publications showcased major improvements in charge storage capacity, conductivity, catalytic activity, long-term stability, and environmental resilience.

I have also contributed extensively to interdisciplinary applications of laser spectroscopy, including biomedical diagnostics, detection of nutritional deficiencies, archaeological artifact characterization, geological material analysis, and structural evaluation of metals, concrete, polymers, and composites. In these works, I identified scientific gaps, designed custom methodologies, supervised experimental execution, and ensured rigorous interpretation of the results.

Throughout all my publications, I played a leading role in scientific writing, data presentation, manuscript refinement, and mentoring junior researchers in ethical, rigorous scientific communication. My contributions reflect a combination of visionary conceptual development, mastery of experimental methodologies, and a commitment to advancing scientific understanding in ways that benefit society.

My Research Leadership

My research leadership has been comprehensive, strategic, and continuously impactful across laboratory development, student mentorship, team building, innovation management, and international collaboration. As the Director of the Laser Research Group at KFUPM since 2009 and a Distinguished Professor since 2010, I have played a central role in establishing one of the most productive and respected research ecosystems in the region.

One of my most enduring accomplishments is the establishment of state-of-the-art laser laboratories at KFUPM. I designed and supervised the acquisition and integration of advanced spectroscopy systems, PLAL nanomaterial synthesis platforms, LIDAR and PAS systems, and analytical instrumentation associated with environmental monitoring, energy storage, hydrogen production, CO_2 conversion, oil-water separation, and clean water technologies. These laboratories now serve as a national and regional hub for interdisciplinary research and have supported hundreds of publications, numerous theses, and major international collaborations.

I have led over 72 funded research projects, including major KACST, SABIC, DSR, and K.A.CARE initiatives aligned with Saudi Arabia's Vision 2030 priority areas. These projects have generated technologies and solutions for wastewater treatment, corrosion monitoring, hydrogen generation, environmental remediation, catalytic conversion systems, and early-stage commercialization efforts. My longstanding role as Senior Research Fellow at K.A.CARE reflects my ongoing contribution to shaping national strategies in renewable energy, carbon management, and sustainable technologies.

My leadership in mentorship and human capital development has been one of the most meaningful dimensions of my work. I have supervised 26 PhD dissertations, 46 Master's theses, more than 20 undergraduate senior projects, and over 30 high school projects, many of which competed internationally at ISEF and other Olympiads. My students now serve in universities, national laboratories, and industry, where they continue to expand the research frontiers I helped establish. My mentorship emphasizes rigorous scientific training, ethical research conduct, and fostering independent critical thinking.

My leadership is also reflected in my ability to build international research networks. I have established long-term collaborations with world-leading institutions, including MIT, Nanjing University, National University of Singapore, Heidelberg University, the Free University of Berlin, and multiple European centers. These collaborations have resulted in joint publications, training programs, scholarly exchanges, and the transfer of advanced technologies and methods. My recognition as a World-Class Professor in Indonesia, my DAAD fellowships in Germany, and my invited participation in global scientific committees including COSPAR reflect my international scientific leadership.

In addition to academic leadership, I have played a major role in innovation and intellectual property development. I have guided my teams in patent drafting, technology evaluation, and pathways toward commercialization. Many innovations emerging from my laboratory such as hydrogen production systems, photocatalytic membranes, environmental sensors, and nanostructured catalysts-have strong industrial relevance and support national technological advancement.

Collectively, my research leadership is defined by my ability to conceptualize emerging scientific directions, build and mentor strong multidisciplinary teams, secure competitive funding, develop world-class research infrastructure, and translate scientific discoveries into impactful technologies that benefit society and advance national priorities. This sustained record of excellence aligns closely with the expectations and responsibilities of a Distinguished Professorship.