# Citation Evidence Report

EB-1A Petition — Original Contributions of Major Significance

8 CFR § 204.5(h)(3)(v) · Criterion 5

## Tong Shen

Postdoctoral Researcher, University of Southern California

Google Scholar profile

**Generated 2026-05-21 by CiteMap.** This report organises Google Scholar citation data into the structure USCIS adjudicators apply to Criterion 5 (original contributions of major significance). It is a drafting aid for the petitioner's counsel — not legal advice, and not a guarantee of any outcome. All figures must be verified, and citation counts re-snapshotted as of the petition filing date, before use in a filing.

## A. Overview & Filtering Statement

| 142 | 157 | 12 | 5 |
|---|---|---|---|
| Citing papers mapped | Citation edges | Home papers mapped | h-index (GS) |

**Filtering statement — methodology & limits**

Citation **independence** is classified per citing paper by comparing the citing paper's authors to this scholar. *Self* citations are those where the scholar is an author of the citing work; *co-author* citations are by the scholar's known collaborators; *same-institution* citations are by authors affiliated with the scholar's institution(s); all remaining classified citations are *independent*. Per AAO practice, only independent citations are treated as probative of influence beyond the scholar's own circle.

**Known limitations — counsel must verify.** (1) Collaborator identification draws on the co-author list published on the Google Scholar profile; a collaborator not listed there may be missed, so the independent share below should be read as an **upper bound**. (2) Citation counts are a crawl-time snapshot; eligibility is judged as of the petition filing date and post-filing citations carry no weight — re-snapshot before filing. (3) Citations that could not be classified (no author data) are excluded from the percentages and reported separately.

## B. Citation Independence

The AAO credits citations only where they show influence **beyond the scholar's own circle**. Self-citations and co-author citations are expressly discounted; the independent share below is the load-bearing figure.

**94.4% independent** of 142 classified citing papers

| Citation type | Count |
|---|---|
| Independent | 134 |
| Self-citation | 4 |
| Co-author | 4 |
| Same-institution | 0 |

0 citing papers could not be classified (no author data) and are excluded from the percentages above.

## C. Significant Contributions & Their Citation Evidence

Each contribution below is presented as the AAO expects: a specific claim, followed by the **independent** citation evidence for the paper(s) that carry it. Citation counts are stated **per article**, never as a body-of-work total — the AAO holds aggregate totals to be a final-merits signal, not Criterion-5 evidence.

Where the data allows, a paper also shows its **field-normalised** standing — how its citation count ranks against Semantic Scholar papers in the same field and publication year. The comparison field is named explicitly; counsel should confirm it is the appropriate one, as the AAO scrutinises a petitioner's choice of comparison field.

## Contribution 1

**Claim — Contribution 1**

*The researcher developed a canonical ensemble auxiliary field quantum Monte Carlo method, enabling precise finite-temperature simulations of interacting fermion systems and establishing a stable recursive algorithm for broader applications.*

The researcher established a foundational method for finite-temperature auxiliary field quantum Monte Carlo simulations within the canonical ensemble, as detailed in their 2020 core paper. This work serves as the technical basis for subsequent advancements in simulating complex fermionic systems.

This line of work appears to address the computational challenges of modeling interacting fermions by introducing a canonical ensemble framework. The titles of follow-up papers from 2023 and 2024 suggest the researcher extended this foundation to create stable recursive algorithms and apply the method to disentangle physics in the attractive Hubbard model using symmetry-resolved entanglement entropies.

The significance of this contribution is evidenced by the core paper's 37 citations, with 97.2% originating from independent researchers. This high rate of independent uptake indicates that the method has been widely adopted by the broader scientific community for studying thermometry and interacting models.

**INDEPENDENT CITATIONS FOR THIS CONTRIBUTION: 48**

**CORE PAPER**

### Finite temperature auxiliary field quantum Monte Carlo in the canonical ensemble

2020 · The Journal of Chemical Physics 153 (20), 2020 · 37 citations (GS)

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| 1 | Taylor series perspective on ab initio path integral Monte Carlo simulations with Fermi-Dirac statistics (2026) | Center for Advanced Systems Understanding, Helmholtz-Zentrum Dresden-Rossendorf, Royal Institute of Technology (KTH) | Germany, Sweden | — |
| 2 | Piecewise interaction picture density matrix quantum Monte Carlo (2022) | University of Iowa | United States | — |
| 3 | Electronic specific heat capacities and entropies from density matrix quantum Monte Carlo using Gaussian process regression to find gradients of noisy data (2023) | University of Iowa | United States | — |
| 4 | Toward first principles-based simulations of dense hydrogen | Center for Advanced Systems Understanding (CASUS), Christian-Albrechts-Universität zu Kiel, Ecole Polytechnique | France, Germany, United Kingdom | — |
| 5 | First principles simulations of dense hydrogen | Centre National de la Recherche Scientifique, École Polytechnique, Commissariat à l'Énergie Atomique et aux Énergies Alternatives, Sorbonne Université, Laboratoire pour l'Utilisation des Lasers Intenses, Centre National de la Recherche Scien- | France, Germany, Italy | — |

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| | | tifique, Université Grenoble Alpes, Christian-Albrechts-Universität zu Kiel | | |
| 6 | The ALF (Algorithms for Lattice Fermions) project release 2.4. Documentation for the auxiliary-field quantum Monte Carlo code | Perimeter Institute for Theoretical Physics, Universität Würzburg, University of Würzburg | Canada, Germany, Israel | — |
| 7 | Real-time quantum dynamics of thermal states with neural thermofields | École Polytechnique Fédérale de Lausanne, EPFL | Switzerland | — |
| 8 | Gaussian-based periodic grand canonical density functional theory with implicit solvation for computational electrochemistry | Harvard University | United States | — |
| 9 | A phaseless auxiliary-field quantum Monte Carlo perspective on the uniform electron gas at finite temperatures: Issues, observations, and benchmark study | Columbia University, Lawrence Livermore National Laboratory | United States | — |
| 10 | On the potentially transformative role of auxiliary-field quantum Monte Carlo in quantum chemistry: A highly accurate method for transition metals and beyond | Center for Theoretical Biological Physics, Columbia University, Flatiron Health (United States) | United States | — |
| 11 | Taylor series perspective on ab initio path integral Monte Carlo simulations with Fermi-Dirac statistics | Center for Advanced Systems Understanding, Helmholtz-Zentrum Dresden-Rossendorf, Royal Institute of Technology (KTH) | Germany, Sweden | — |
| 12 | Improved modularity and new features in ipie: Toward even larger AFQMC calculations on CPUs and GPUs at zero and finite temperatures | Columbia University, Google Research, Harvard University | France, United States | — |
| 13 | Quadratic scaling bosonic path integral molecular dynamics | Tel Aviv University | Israel | — |
| 14 | Excitations of quantum many-body systems via purified ensembles: A unitary-coupled-cluster-based approach | CNR, INO-CNR, Max Planck Institute for the Physics of Complex Systems | Germany, Italy | — |
| 15 | Toward an accurate equation of state and B1-B2 phase boundary for magnesium oxide up to terapascal pressures and electron-volt temperatures | Lawrence Livermore National Laboratory, University of Rochester | United States | Background |
| 16 | Casimir and Helmholtz forces in one-dimensional Ising model with Dirichlet (free) boundary conditions | Bulgarian Academy of Sciences, University of California, Los Angeles | Bulgaria, United States | — |
| 17 | Reweighting Scheme for the Calculation of Grand-Canonical Expectation Values in Quantum Monte Carlo Simulations With a Fermion Sign Problem | Helmholtz-Zentrum Dresden-Rossendorf, Universität Rostock | Germany | — |
| 18 | Multi-body wave function of ground and low-lying excited states using unornamented deep neural networks | Kyoto University, Nagoya University, RIKEN | Japan | **Methodology** |

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| 19 | Mechanisms of Temperature Control of Singlet Fission in an Optical Cavity | Hangzhou Dianzi University, Nanyang Technological University | China, Singapore | — |
| 20 | Analyzing X-ray Thomson scattering experiments of warm dense matter in the imaginary-time domain: Theoretical models and simulations | Center for Advanced Systems Understanding, Helmholtz-Zentrum Dresden-Rossendorf | Germany | Background |
| 21 | Frontiers of stochastic electronic structure calculations | Lawrence Livermore National Laboratory, Quantum Simulations (United States), Sandia National Laboratories, University of Illinois Urbana-Champaign | United States | — |
| 22 | Fermionic neural Gibbs states | ETH Zürich | Switzerland | — |
| 23 | Exact kinetic propagators for coherent state complex Langevin simulations | University of California, Santa Barbara | United States | — |
| 24 | Removing Basis Set Incompleteness Error in Finite-Temperature Electronic Structure Calculations: Two-Electron Systems | Michigan State University | United States | — |
| 25 | Thermal coupled cluster theory for SU (2) systems | Rice University | United States | — |
| 26 | Phase diagram of the antiferromagnet of spin on a square lattice | Klinik und Poliklinik für Psychosomatik und Psychotherapie | Germany | **Methodology** |
| 27 | Precision thermodynamics of the strongly interacting Fermi gas in two dimensions | University of Louisville, Yale University | United States | — |
| 28 | Electronic Free Energy Surface of the Nitrogen Dimer Using First-Principles Finite Temperature Electronic Structure Methods | University of Iowa | United States | — |
| 29 | The sign problem in density matrix quantum Monte Carlo | University of Iowa | United States | — |
| 30 | Fermionic-propagator and alternating-basis quantum Monte Carlo methods for correlated electrons on a lattice | University of Belgrade | Serbia | — |

**Showing the 30 most-cited of 35 independent citing papers.**

Independent citing papers only; self- and co-author citations excluded. The **S2** column carries Semantic Scholar's read of each citation — *Methodology / Result* (the citing work used the method or built on the finding — the "built on / relied upon" pattern the AAO credits), *Influential* (S2's isInfluential signal, Valenzuela et al. 2015), or *Background* (a passing mention).

### Citing-text excerpts — how the field used this work

**METHODOLOGY** Multi-body wave function of ground and low-lying excited states using unornamented deep neural networks

*"...Monte Carlo method (QMC) including the variational Monte Carlo, diffusion Monte Carlo (DMC), and auxiliary-field quantum Monte Carlo methods [13–19], the configuration interaction method [20–22], the coupled cluster method [23–26], the density functional theory (DFT) [27–29], the density..."*

**METHODOLOGY** Phase diagram of the antiferromagnet of spin on a square lattice

*"Notice that, unlike available techniques for canonical QMC simulations [35, 36], where the global charge of the system is fixed, here we need to impose half-filling on each lattice site."*

## FOLLOW-UP WORK

### Disentangling the physics of the attractive Hubbard model as a fully interacting model of fermions via the accessible and symmetry-resolved entanglement entropies

2024 · Physical Review B 109 (19), 195119, 2024 · 3 citations (GS)

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| 1 | Revisiting the symmetry-resolved entanglement for noninvertible symmetries in conformal field theories | The University of Melbourne | Australia | Background |
| 2 | Local classical correlations between physical electrons in the Hubbard model | Centre National de la Recherche Scientifique, Commissariat à l'Énergie Atomique et aux Énergies Alternatives, Université Paris-Saclay, CEA Paris-Saclay, Centre National de la Recherche Scientifique, École Polytechnique, Commissariat à l'Énergie Atomique et aux Énergies Alternatives, Université Paris-Saclay, Institut Rayonnement-Matière de Saclay, CEA Paris-Saclay, Centre National de la Recherche Scientifique, Laboratoire de Cristallographie, Résonance Magnétique et Modélisations, Université de Lorraine | Canada, France, Germany | — |
| 3 | Local classical correlations between physical electrons in Hubbard systems | Consiglio Nazionale delle Ricerche, SISSA, Scuola Internazionale Superiore di Studi Avanzati | Italy | — |

Independent citing papers only; self- and co-author citations excluded. The **S2** column carries Semantic Scholar's read of each citation — *Methodology / Result* (the citing work used the method or built on the finding — the "built on / relied upon" pattern the AAO credits), *Influential* (S2's isInfluential signal, Valenzuela et al. 2015), or *Background* (a passing mention).

**FOLLOW-UP WORK**

### Stable recursive auxiliary field quantum Monte Carlo algorithm in the canonical ensemble: Applications to thermometry and the Hubbard model

2023 · Physical Review E 107 (5), 055302, 2023 · 12 citations (GS)

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| 1 | Quadratic scaling bosonic path integral molecular dynamics | Tel Aviv University | Israel | — |
| 2 | Exact kinetic propagators for coherent state complex Langevin simulations | University of California, Santa Barbara | United States | — |
| 3 | Electronic Free Energy Surface of the Nitrogen Dimer Using First-Principles Finite Temperature Electronic Structure Methods | University of Iowa | United States | — |

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| 4 | Fermionic-propagator and alternating-basis quantum Monte Carlo methods for correlated electrons on a lattice | University of Belgrade | Serbia | — |
| 5 | Quantum sensing with ultracold simulators in lattice and ensemble systems: A review | Harish-Chandra Research Institute | India | — |
| 6 | Projected complex Langevin sampling method for bosons in the canonical and microcanonical ensembles | University of California, Santa Barbara | United States | — |
| 7 | Thermodynamics of the Fermi-Hubbard Model through Stochastic Calculus and Girsanov Transformation | Hochschule RheinMain | Germany | — |
| 8 | Pseudogap regime of the unitary Fermi gas with lattice auxiliary-field quantum Monte Carlo in the continuum limit | Quantinuum, Yale University | United States | — |
| 9 | Field-Theoretic Methods for Bosonic Systems | Institute of Applied Physics | Russia | — |
| 10 | Fermionic-propagator and alternating-basis quantum Monte Carlo methods for correlated electrons on a lattice | University of Belgrade | Serbia | — |

Independent citing papers only; self- and co-author citations excluded. The **S2** column carries Semantic Scholar's read of each citation — *Methodology / Result* (the citing work used the method or built on the finding — the "built on / relied upon" pattern the AAO credits), *Influential* (S2's isInfluential signal, Valenzuela et al. 2015), or *Background* (a passing mention).

## Contribution 2

**Claim — Contribution 2**

*The researcher advanced TiO2 photocatalysis by investigating bulk/surface defect ratios and Fe-doping strategies, establishing a foundational framework for optimizing nanosheet and hierarchical structures.*

The researcher's contribution centers on optimizing titanium dioxide photocatalysts through defect engineering and structural modification. This line of work is anchored by a 2017 core paper examining the effect of bulk/surface defects ratios on TiO2 nanosheet films, which has accumulated 54 citations. The titles indicate a focus on manipulating material properties to enhance photocatalytic efficiency.

Originality in this work appears to lie in the systematic exploration of defect ratios and subsequent doping strategies. Following the core study, the researcher published a 2018 paper on Fe-doped hierarchical TiO2 ball-flowers, suggesting an evolution from fundamental defect analysis to applied structural enhancements. This progression implies a novel approach to tailoring TiO2 morphology and composition for improved water-splitting performance.

The significance of this research is evidenced by strong independent uptake. The core paper's 54 citations and the follow-up's 29 citations demonstrate sustained interest. Notably, 97.2% of the 142 classified citations originate from independent researchers, indicating that the broader scientific community has adopted these findings to advance their own work in photocatalysis and materials science.

**INDEPENDENT CITATIONS FOR THIS CONTRIBUTION: 80**

**CORE PAPER**

### The effect of bulk/surface defects ratio change on the photocatalysis of TiO2 nanosheet film

2017 · Applied Surface Science 410, 513-518, 2017 · 54 citations (GS)

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| 1 | Hierarchically macro–meso–microporous metal–organic framework for photocatalytic oxidation (2020) | — | — | — |
| 2 | Improved dark ambient degradation of organic pollutants by cerium strontium cobalt perovskite (2020) | Queensland University of Technology, Universidade Nova de Lisboa, Rede de Química e Tecnologia, University of Science and Technology of China, Hefei National Center for Physical Sciences at Nanoscale | Australia, China, Portugal | — |
| 3 | Synergetic effects of the interfacial dyadic structure on the interfacial charge transfer between surface-complex and TiO2 (2019) | Fujian Agriculture and Forestry University, Fujian Agriculture and Forestry University, Fuzhou University, Fujian Electric Power Survey & Design Institute | China | — |
| 4 | Charge carrier transfer in photocatalysis (2020) | Institute of Materials Research and Engineering, Agency for Science, Technology and Research, Leibniz University Hannover, St Petersburg University, North China Electric Power University | China, Germany, Singapore | — |
| 5 | Design and application of various visible light responsive metal oxide photocatalysts (2020) | — | — | — |
| 6 | Comparisons of magnetic defects and coercive forces for Co/Si (100) and Co/rubrene/Si (100) (2020) | — | — | — |
| 7 | Enhanced photocatalytic degradation of N-doped TiO2-SiO2 composite for degradation of phenol under simulated natural light assisted by S2O8 2- ... (2021) | Ho Chi Minh City University of Technology, Vietnam National University Ho Chi Minh City | Vietnam | — |
| 8 | Optimum anatase/rutile ratios of TiO2 for photocatalytic denitrification from IX brine waste and real RO concentrate: RSM-CCD model and the use of an economical ... (2023) | Ilam University of Medical Sciences, University of Tehran | Iran | — |
| 9 | [illegible] (2019) | — | — | — |
| 10 | TiO2 [illegible] Ag [illegible] (2018) | — | — | — |
| 11 | [illegible] B (2020) | [illegible] | [illegible] | — |
| 12 | Carbon material selection and performance enhancement mechanism for constructing highly active Ag3PO4-based hybrid photocatalysts modified with diverse ... (2024) | Sichuan University, Western Metal Materials (China) | China | — |
| 13 | Ultra-fast green synthesis of a defective TiO 2 photocatalyst towards hydrogen production | — | — | — |
| 14 | Highly photocatalytic activity of nanocrystalline TiO2 (anatase, rutile) powders prepared from TiCl4 by sol–gel method in aqueous solutions. | Université Claude Bernard Lyon 1, Centre National de la Recherche Scientifique, Institut | France, Saudi Arabia | — |

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| | | de Recherches sur la Catalyse et l'Environnement de Lyon, University of Gabès, Université Claude Bernard Lyon 1, Institut de Recherches sur la Catalyse et l'Environnement de Lyon, Centre National de la Recherche Scientifique, Université Claude Bernard Lyon 1, University of Gabès, Centre National de la Recherche Scientifique, Automation and Process Engineering Laboratory | | |
| 15 | TiO2 coated complex 3D Foams: Physical properties and photocurrent generation mechanisms | Centre National de la Recherche Scientifique, Institut Jean Lamour, Université de Lorraine, University of Namur, University of Namur, Advanced Coatings (Belgium) | Belgium, France | — |
| 16 | EPR evidence of carrier effect on unpaired-electron number of Mn in SCR: The good, the bad, the ugly | Shanghai Academy of Environmental Sciences, Shanghai University | China | — |
| 17 | Ilmenite-type MgTiO3 ceramics by complex (Mn1/2W1/2) 4+ cation co-substitution producing improved microwave characteristics | — | — | — |
| 18 | Design of plasmonic Ag-TiO2/H3PW12O40 composite film with enhanced sunlight photocatalytic activity towards o-chlorophenol degradation | — | — | — |
| 19 | Combined spectroscopic methods of determination of density of electronic states: comparative analysis of diffuse reflectance spectroelectrochemistry and reversed ... | Hokkaido University, Jagiellonian University | Japan, Poland | — |
| 20 | Improving the humidity sensing below 30% RH of TiO2 with GO modification | — | — | — |
| 21 | Plasma dynamic synthesis of highly defective fine titanium dioxide with tunable phase composition | — | — | — |
| 22 | Engineering the defect distribution in ZnO nanorods through laser irradiation | — | — | — |
| 23 | Preparation of nitrogen-doped aluminium titanate (Al2TiO5) nanostructures: application to removal of organic pollutants from aqueous media | — | — | — |
| 24 | A facile “dark”-deposition approach for Pt single-atom trapping on facetted anatase TiO2 nanoflakes and use in photocatalytic H2 generation | Friedrich-Alexander-Universität Erlangen-Nürnberg, Friedrich-Alexander-Universität Erlangen-Nürnberg, King Abdulaziz | Czech Republic, Germany | — |

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| | | University, Regional Centre of Advanced Technologies and Materials, Friedrich-Alexander-Universität Erlangen-Nürnberg, Tohoku University | | |
| 25 | Photocatalytic application of defective WO3 nanoparticles for precious metal recovery from plating effluent | Chulalongkorn University, Mahidol University, The Royal College Of Anesthesiologists Of Thailand, Office of the Royal Society, Mahidol University | Thailand | — |
| 26 | Interfacial Charge Transfer in Defect-Rich Ti3C2/BiOIO3 Heterostructured Photocatalysts for the Degradation of Methyl Orange | Anhui Jianzhu University | China | — |
| 27 | A 2D ZnSe/BiOX vertical heterostructure as a promising photocatalyst for water splitting: A first-principles study | — | — | — |
| 28 | Effect of phase composition on the photocatalytic activity of titanium dioxide obtained from supercritical antisolvent | — | — | — |
| 29 | Facile synthesis of nitrogen doped ordered mesoporous TiO2 with improved humidity sensing properties | Yangzhou University | China | — |
| 30 | Electronic and optical properties of GaN/MoSe2 and its vacancy heterojunctions studied by first-principles | Yili Normal University | China | — |

**Showing the 30 most-cited of 51 independent citing papers.**

Independent citing papers only; self- and co-author citations excluded. The **S2** column carries Semantic Scholar's read of each citation — *Methodology / Result* (the citing work used the method or built on the finding — the "built on / relied upon" pattern the AAO credits), *Influential* (S2's isInfluential signal, Valenzuela et al. 2015), or *Background* (a passing mention).

**FOLLOW-UP WORK**

### Enhanced photocatalytic water-splitting performance using Fe-doped hierarchical TiO2 ball-flowers

2018 · Nanotechnology 29 (3), 035702, 2018 · 29 citations (GS)

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| 1 | A critical review in strategies to improve photocatalytic water splitting towards hydrogen production | University of Technology Malaysia | Malaysia | — |
| 2 | Nanostructured semiconductor supported iron catalysts for heterogeneous photo-Fenton oxidation: a review | Soochow University | China | — |
| 3 | Enhanced photocatalytic hydrogen production and degradation of organic pollutants from Fe (III) doped TiO2 nanoparticles | Carl von Ossietzky Universität Oldenburg | Germany | — |
| 4 | Surface and interface engineering of hierarchical photocatalysts | Nankai University, South China Agricultural University, Univer- | China | — |

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| | | sity of Electronic Science and Technology of China | | |
| 5 | Iron-based photocatalytic and photoelectrocatalytic nano-structures: Facts, perspectives, and expectations | — | — | — |
| 6 | Synthesis of NiSe2@ M (M= Cu, Fe and Zn)–NiCo LDH with porous structure on nickel foam for overall fresh and seawater splitting | North University of China | China | — |
| 7 | Low temperature synthesis of BiFeO 3 nanoparticles with enhanced magnetization and promising photocatalytic performance in dye degradation and hydrogen … | Bangladesh University of Engineering and Technology | Bangladesh | — |
| 8 | Progress in scalable photocatalytic hydrogen production from water and techno-economic insights | — | — | — |
| 9 | Facile synthesis of Pr-doped molecularly imprinted TiO2 mesocrystals with high preferential photocatalytic degradation performance | — | — | — |
| 10 | A facile synthesis of Zn-doped TiO 2 nanoparticles with highly exposed (001) facets for enhanced photocatalytic performance | — | — | — |
| 11 | Fe3+-Doped Anatase TiO2 Study Prepared by New Sol-Gel Precursors | — | — | — |
| 12 | Plasma technology applications in proton exchange membrane fuel cell systems | China University of Petroleum-Beijing at Karamay, Shanghai Polytechnic University, Yangtze University | China | — |
| 13 | Design and synthesis of hybrid nanostructures for sustainable energy and environmental remediation | Central University of Gujarat, Malaviya National Institute of Technology | India | — |
| 14 | The synergistic effect of Bi and Fe co-doping on surface functionalization of microporous aluminophosphate photocatalysts for enhanced visible light H2 generation | — | — | — |
| 15 | Ta2O5-incorporated in photoinduced electrocatalyst of TiO2-RuO2 decorated by PPy-NrGO nanocomposite for boosting overall water splitting | — | — | — |
| 16 | Theoretical investigations of optoelectronic properties, photocatalytic performance as a water splitting photocatalyst and band gap engineering with transition metals … | Government College University, Faisalabad, Government College Women University Faisalabad | Pakistan | — |
| 17 | Development of modified TiO2 for photocatalytic hydrogen production | Lanzhou University of Technology | China | — |
| 18 | Highly visible-light-responsive Cu2O/rGO decorated with Fe3O4@SiO2 nanoparticles as a magnetically recyclable photocatalyst | University of Electronic Science and Technology of China | China | — |

| No. | Citing paper | Citing institution(s) | Country | S2 |
|---|---|---|---|---|
| 19 | Synthesis of Fe-TiO2 and Cu-TiO2 Based Materials by Olive Leaves Biotemplating—Application to Hydrogen Production from Glycerol Photoreforming | University of Córdoba | Spain | — |
| 20 | Application of TiO2-based nanocomposites for simultaneous H2 production and biodiesel wastewater remediation | Chulalongkorn University, Chulalongkorn University, Petromat, The Royal College Of Anesthesiologists Of Thailand, Mahidol University, Office of the Royal Society | Thailand | — |
| 21 | Hydrogen production by catalytic reforming process | The University of Tokyo, University of Science and Technology of China | China, Japan | — |
| 22 | Enhanced photocatalytic hydrogen production of Fe2O3 decorated TiO2 Nanorods: optimization of hydrothermal temperature | — | — | — |
| 23 | Tailoring the Surface Chemistry of Metal Oxides for Applications in Sustainable Catalysis | — | — | — |
| 24 | Development and analysis of novel photoelectrochemical reactor for solar based clean hydrogen production | HOPE Clinic, SLAC National Accelerator Laboratory, Stanford University, SLAC National Accelerator Laboratory, Stanford University, McMaster University | Canada, United States | — |
| 25 | Research Progress of Modified TiO2 in Photocatalytic Water Splitting for Hydrogen Production | Brookhaven National Laboratory, Dalian University of Technology, Japan Science and Technology Agency, National Institute of Advanced Industrial Science and Technology | China, Japan, United States | — |
| 26 | SILVER-MONTMORILLONITE MODIFIED TITANIUM DIOXIDE ASSISTED CARBON NITRIDE NANOCOMPOSITES FOR PHOTOCATALYTIC HYDROGEN ... | — | — | — |
| 27 | □□ TiO2 □□□□□□□□□□□□□□□□ | Heilongjiang University | China | — |
| 28 | Fe3+-Doped Anatase TiO2 Study Prepared by New Sol-Gel Precursors | — | — | — |
| 29 | □□□□□ TiO2 □□□□□□□□□□□□□□□□ | — | — | — |

Independent citing papers only; self- and co-author citations excluded. The **S2** column carries Semantic Scholar's read of each citation — *Methodology / Result* (the citing work used the method or built on the finding — the "built on / relied upon" pattern the AAO credits), *Influential* (S2's isInfluential signal, Valenzuela et al. 2015), or *Background* (a passing mention).

## D. Citing-Institution Prestige & Geography

### Top citing institutions

| Institution | Country | World ranking | Citing papers |
|---|---|---|---|
| Lawrence Livermore National Laboratory | United States | SCImago #1482 | 6 |
| Helmholtz-Zentrum Dresden-Rossendorf | Germany | SCImago #2809 | 5 |
| Columbia University | United States | SCImago #65 · THE 20 · QS =38 | 4 |
| University of Iowa | United States | SCImago #615 · THE 301–350 · QS =530 | 4 |
| Brown University | United States | SCImago #553 · THE 65 · QS 69 | 4 |
| Rice University | United States | SCImago #818 · THE =103 · QS =119 | 4 |
| University of Tennessee | United States | — | 3 |
| University of Rochester | United States | SCImago #524 · THE 127 · QS 236 | 3 |
| Center for Advanced Systems Understanding | Germany | — | 3 |
| Harvard University | United States | SCImago #4 · THE =5 · QS 5 | 2 |
| University of Belgrade | Serbia | SCImago #1090 · THE 1001–1200 · QS 761-770 | 2 |
| Henan University | China | SCImago #1369 | 2 |
| University of Michigan | United States | SCImago #43 · THE 23 · QS 45 | 2 |
| Royal Institute of Technology (KTH) | Sweden | SCImago #497 | 2 |
| University of Illinois at Urbana-Champaign | United States | SCImago #206 · THE =41 | 2 |

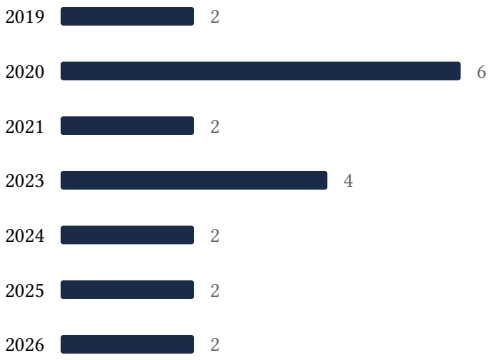
## Geographic distribution of citing authors

| Country | Citing papers |
|---|---|
| United States | 39 |
| China | 32 |
| Germany | 16 |
| France | 7 |
| United Kingdom | 6 |
| India | 5 |
| Italy | 5 |
| Japan | 5 |
| Canada | 4 |
| Switzerland | 3 |
| Israel | 3 |
| Thailand | 2 |

Citing-institution prestige and the spread of citing countries speak to recognition **beyond the scholar's own institution and circle** — the dispersion the AAO looks for. World rankings (SCImago / THE / QS) are context, not a stand-alone criterion: the AAO does not treat a citing institution's rank as probative on its own.

## E. Citation Growth Over Time

Distinct citing papers by publication year. Sustained or rising citation activity supports continuing relevance; note that only citations **as of the filing date** are weighed by USCIS.




## F. AAO Precedent Considerations

### Pre-filing self-check (AAO denial patterns)

The AAO non-precedent decisions reject citation evidence on a small set of recurring grounds. Confirm the petition addresses each before filing:

- ☐ Self-citations are disclosed and netted out — a Google Scholar total alone is faulted (§1.1).
- ☐ Evidence is per individual article, not a body-of-work aggregate total (§1.2).
- ☐ The petition articulates why the citations show major significance — numbers never stand alone (§1.5).
- ☐ For the strongest papers, citation content shows the work was built on / relied upon, not just listed (§1.6, §2.2).
- ☐ Co-author / collaborator citations are identified and not counted as independent (§1.7).
- ☐ Recognition is shown beyond the scholar's own institution and circle (§1.8).
- ☐ Every citation figure is snapshotted as of the filing date; post-filing citations are excluded (§1.9).
- ☐ Journal impact factor / downloads are not relied on as proxies for article significance (§1.10, §1.12).
- ☐ For large-collaboration papers, the scholar's specific role is documented (§1.13).
- ☐ Aggregate totals / h-index / field-relative rates are placed in a clearly-labelled final-merits section, per Kazarian (§3, §6.1.7).

**Disclaimer**

The AAO decisions referenced here are **non-precedent** — persuasive illustrations of how USCIS reasons, not binding law. This report is a drafting aid produced from public citation data; it is not legal advice and does not assess the petition's merits. All analysis must be reviewed by qualified immigration counsel.

## G. Citation Evidence Index

Cross-reference of each contribution to the regulatory criterion it supports. Counsel should map these to the petition's exhibit numbers.

| Contribution | Core paper | Indep. cites | Supports |
|---|---|---|---|
| Contribution 1 | Finite temperature auxiliary field quantum Monte Carlo in the canonical ensemble | 48 | 8 CFR 204.5(h)(3)(v) — Criterion 5 |
| Contribution 2 | The effect of bulk/surface defects ratio change on the photocatalysis of TiO2 nanosheet film | 80 | 8 CFR 204.5(h)(3)(v) — Criterion 5 |