**Scientometric review of sustainable fire-resistant polysaccharide-based composite aerogels**

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**SUPPLEMENTARY MATERIAL**

Tables were generated from VOSviewer and Biblioshiny software

Data was obtained from Scopus database

*S.* Table 1: Document search in Scopus database and resulting documents as of June 2023.

|  |  |
| --- | --- |
| **Parameters** | **Settings** |
| TITLE-ABS-KEY | (flame AND retardant AND aerogel) |
| Period | 2003-2023 |
| Doc Type | Articles and Review |
| Source Type | Journal |
| Language | English |
| Total Documents | 243 |

**Note:** *TITLE-ABS-KEY means Title, Abstract, and Keywords*

*S.* Table 2: List of the primary sources in the relevant field of study

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| S/N | Source | Documents | Citations | Total link strength |
| 1 | ACS Applied Materials and Interfaces | 16 | 1054 | 2113 |
| 2 | Chemical Engineering Journal | 14 | 614 | 1041 |
| 3 | Composites Part B: Engineering | 10 | 238 | 1744 |
| 4 | ACS Sustainable Chemistry and Engineering | 9 | 565 | 1331 |
| 5 | Carbohydrate Polymers | 9 | 469 | 892 |
| 6 | Composites Part A: Applied Science and Manufacturing | 7 | 149 | 673 |
| 7 | Polymers | 7 | 125 | 830 |
| 8 | Cellulose | 6 | 74 | 572 |
| 9 | Journal Of Applied Polymer Science | 6 | 87 | 326 |
| 10 | Journal Of Hazardous Materials | 6 | 266 | 546 |
| 11 | ACS Applied Polymer Materials | 5 | 36 | 581 |
| 12 | Industrial And Engineering Chemistry Research | 5 | 38 | 255 |
| 13 | ACS Applied Nano Materials | 4 | 24 | 241 |
| 14 | International Journal of Biological Macromolecules | 4 | 14 | 209 |
| 15 | Journal Of Materials Chemistry A | 4 | 183 | 315 |
| 16 | Materials and Design | 4 | 129 | 221 |
| 17 | Polymer Degradation and Stability | 4 | 50 | 339 |
| 18 | Applied Clay Science | 3 | 31 | 470 |
| 19 | Applied Surface Science | 3 | 85 | 360 |
| 20 | Composites Communications | 3 | 46 | 244 |
| 21 | Composites Science and Technology | 3 | 151 | 180 |
| 22 | Construction and Building Materials | 3 | 74 | 60 |
| 23 | Polymers for Advanced Technologies | 3 | 65 | 624 |
| 24 | ACS Nano | 2 | 82 | 33 |
| 25 | Advanced Functional Materials | 2 | 115 | 144 |
| 26 | Colloids and Surfaces A: Physicochemical and Engineering Aspects | 2 | 3 | 249 |
| 27 | Frontiers in Materials | 2 | 13 | 118 |
| 28 | International Journal of Molecular Sciences | 2 | 1 | 165 |
| 29 | Journal of Colloid and Interface Science | 2 | 13 | 80 |
| 30 | Journal of Energy Storage | 2 | 14 | 16 |
| 31 | Journal of Materials Science and Technology | 2 | 75 | 313 |
| 32 | Journal of Porous Materials | 2 | 2 | 21 |
| 33 | Journal of the Taiwan Institute of Chemical Engineers | 2 | 12 | 242 |
| 34 | Journal of the Textile Institute | 2 | 37 | 24 |
| 35 | Materials | 2 | 56 | 200 |
| 36 | Nano Energy | 2 | 77 | 69 |
| 37 | Polymer Engineering and Science | 2 | 10 | 175 |
| 38 | Polymer Reviews | 2 | 59 | 744 |
| 39 | Progress In Organic Coatings | 2 | 4 | 111 |
| 40 | RSC Advances | 2 | 21 | 219 |

*S.* Table 3: List of the top cited documents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S/N | Document | Document Title | Citations | Total link strength | Ref |
| 1 | Wicklein B. (2015) | Thermally insulating and fire-retardant lightweight anisotropic foams based on nanocellulose and graphene oxide | 975 | 97 | [1] |
| 2 | Liang C. (2020) | Ultra-light MXene aerogel/wood-derived porous carbon composites with wall-like “mortar/brick” structures for electromagnetic interference shielding | 299 | 13 | [2] |
| 3 | Wang N.-N. (2019) | Robust, Lightweight, Hydrophobic, and Fire-Retarded Polyimide/MXene Aerogels for Effective Oil/Water Separation | 162 | 60 | [3] |
| 4 | Wang D. (2020) | Biomimetic structural cellulose nanofiber aerogels with exceptional mechanical, flame-retardant and thermal-insulating properties | 130 | 221 | [4] |
| 5 | Luo Y. (2021) | Flame-retardant and form-stable phase change composites based on MXene with high thermostability and thermal conductivity for thermal energy storage | 106 | 21 | [5] |
| 6 | He C. (2018) | Mechanically Resistant and Sustainable Cellulose-Based Composite Aerogels with Excellent Flame Retardant, Sound-Absorption, and Superantiwetting Ability for Advanced Engineering Materials | 104 | 255 | [6] |
| 7 | Maleki H. (2018) | Compressible, Thermally Insulating, and Fire Retardant Aerogels through Self-Assembling Silk Fibroin Biopolymers Inside a Silica Structure—An Approach towards 3D Printing of Aerogels | 102 | 124 | [7] |
| 8 | Wang Y. (2020) | Multifunctional polyimide aerogel textile inspired by polar bear hair for thermoregulation in extreme environments | 97 | 61 | [8] |
| 9 | Cao Y (2022) | Flame-retardant and leakage-proof phase change composites based on MXene/polyimide aerogels toward solar thermal energy harvesting | 96 | 26 | [9] |
| 10 | Pirzada T. (2020) | Cellulose Silica Hybrid Nanofiber Aerogels: From Sol–Gel Electrospun Nanofibers to Multifunctional Aerogels | 89 | 119 | [10] |
| 11 | Zhang Q. (2017) | Flyweight, Superelastic, Electrically Conductive, and Flame-Retardant 3D Multi-Nanolayer Graphene/Ceramic Metamaterial | 80 | 81 | [11] |
| 12 | Kang W. (2020) | A novel robust adsorbent for efficient oil/water separation: Magnetic carbon nanospheres/graphene composite aerogel | 74 | 33 | [12] |
| 13 | Carosio F. (2018) | Graphene Oxide Exoskeleton to Produce Self-Extinguishing, Nonignitable, and Flame Resistant Flexible Foams: A Mechanically Tough Alternative to Inorganic Aerogels | 55 | 134 | [13] |
| 14 | Ahmed A. (2019) | Fire-retardant, self-extinguishing triboelectric nanogenerators | 47 | 60 | [14] |
| 15 | Zhang Z.-H. (2022) | Silicone/graphene oxide co-cross-linked aerogels with wide-temperature mechanical flexibility, super-hydrophobicity and flame resistance for exceptional thermal insulation and oil/water separation | 46 | 154 | [15] |
| 16 | Zhao K. (2020) | Charged graphene aerogel filter enabled superior particulate matter removal efficiency in harsh environment | 44 | 18 | [16] |
| 17 | Sheng X. (2019) | Synergistic Effects of Two-Dimensional MXene and Ammonium Polyphosphate on Enhancing the Fire Safety of Polyvinyl Alcohol Composite Aerogels | 36 | 140 | [17] |
| 18 | Lee H. (2019) | Super-insulating, flame-retardant, and flexible poly(dimethylsiloxane) composites based on silica aerogel | 34 | 102 | [18] |
| 19 | Sun J. (2021) | Thermal-insulating, flame-retardant and mechanically resistant aerogel based on bio-inspired tubular cellulose | 31 | 86 | [19] |
| 20 | Du Y. (2022) | Ultralight, highly compressible, thermally stable MXene/aramid nanofiber anisotropic aerogels for electromagnetic interference shielding | 30 | 22 | [20] |
| 21 | Zhang Z. (2019) | Resilient, fire-retardant and mechanically strong polyimide-polyvinylpolymethylsiloxane composite aerogel prepared via stepwise chemical liquid deposition | 30 | 80 | [21] |
| 22 | Qian Z. (2019) | Triboelectric nanogenerators made of polybenzazole aerogels as fire-resistant negative tribo-materials | 30 | 21 | [22] |
| 23 | Motahari S. (2015) | Thermal and Flammability Properties of Polypropylene/Silica Aerogel Composites | 30 | 7 | [23] |
| 24 | Tian J. (2022) | Highly flexible and compressible polyimide/silica aerogels with integrated double network for thermal insulation and fire-retardancy | 29 | 167 | [24] |
| 25 | Le D.K. (2019) | Applications of functionalized polyethylene terephthalate aerogels from plastic bottle waste | 27 | 50 | [25] |
| 26 | Yang Y. (2021) | Flame-Retardant Host–Guest Films for Efficient Thermal Management of Cryogenic Devices | 26 | 23 | [26] |
| 27 | Chen F. (2018) | Heat insulating, fire retardant and flexible inorganic nanocomposite paper | 26 | 45 | [27] |
| 28 | Li Z. (2019) | Reducing the flammability of hydrophobic silica aerogels by doping with hydroxides | 25 | 239 | [28] |
| 29 | Cheng H. (2016) | Super flame-retardant lightweight rime-like carbon-phenolic nanofoam | 25 | 56 | [29] |
| 30 | Shu R. (2022) | Facile construction of three-dimensional porous netlike reduced graphene oxide/zinc oxide composite aerogels as the lightweight, flame retardant, compression resilience and high-performance electromagnetic wave absorbers | 24 | 5 | [30] |
| 31 | Zuo B. (2021) | Flame-retardant cellulose nanofiber aerogel modified with graphene oxide and sodium montmorillonite and its fire-alarm application | 23 | 198 | [31] |
| 32 | Malakooti S. (2019) | Low-Cost, Ambient Dried, Superhydrophobic, High Strength, Thermally Insulating and Thermally Resilient Polybenzoxazine Aerogels | 23 | 30 | [32] |
| 33 | Yang W. (2021) | Design of Intrinsically Flame-Retardant Vanillin-Based Epoxy Resin for Thermal-Conductive Epoxy/Graphene Aerogel Composites | 22 | 16 | [33] |
| 34 | Liang W. (2019) | Facile preparation of attapulgite-based aerogels with excellent flame retardancy and better thermal insulation properties | 21 | 129 | [34] |
| 35 | Cao C. (2021) | Thermally induced fire early warning aerogel with efficient thermal isolation and flame-retardant properties | 20 | 148 | [35] |
| 36 | Zhang D. (2021) | Mechanically strong polyimide aerogels cross-linked with dopamine-functionalized carbon nanotubes for oil absorption | 19 | 100 | [36] |
| 37 | Hai Y. (2020) | Layer-by-Layer Assembly of Aerogel and Alginate toward Self-Extinguishing Flexible Polyurethane Foam | 15 | 49 | [37] |
| 38 | Wang L. (2019b) | Superelastic, Anticorrosive, and Flame-Resistant Nitrogen-Containing Resorcinol Formaldehyde/Graphene Oxide Composite Aerogels | 15 | 187 | [38] |
| 39 | Riahipour R. (2018) | Improving flame-retardant, thermal, and mechanical properties of an epoxy using halogen-free fillers | 15 | 36 | [39] |
| 40 | Zhang Y. (2022) | Tightly-packed fluorinated graphene aerogel/polydimethylsiloxane composite with excellent thermal management properties | 14 | 3 | [40] |
| 41 | Wu Z.-H. (2023) | Silane modified MXene/polybenzazole nanocomposite aerogels with exceptional surface hydrophobicity, flame retardance and thermal insulation | 11 | 48 | [41] |
| 42 | Niu J. (2022) | Experimental study on low thermal conductive and flame retardant phase change composite material for mitigating battery thermal runaway propagation | 11 | 6 | [42] |
| 43 | Zhao H. (2022) | Lightweight and mechanically robust carbon aerogel/SnO2 nanorods composites with heterogeneous structure for electromagnetic interference shielding | 9 | 14 | [43] |
| 44 | Dan H. (2022) | Fabrication of superhydrophobic Enteromorpha-derived carbon aerogels via NH4H2PO4 modification for multi-behavioral oil/water separation | 9 | 14 | [44] |
| 45 | Huang J. (2022a) | High enthalpy efficiency lignin-polyimide porous hybrid aerogel composite phase change material with flame retardancy for superior solar-to-thermal energy conversion and storage | 8 | 10 | [45] |
| 46 | Luo Z. (2022) | Efficient flame-retardant biomass aerogel endowed with graphene oxide interconnected networks for ultrasensitive fire warning | 8 | 29 | [46] |
| 47 | Shen R. (2022) | Biomass modified boron nitride/polyimide hybrid aerogel supported phase change composites with superior energy storage capacity and improved flame retardancy for solar-thermal energy storage | 7 | 35 | [47] |
| 48 | Niu Q. (2022c) | Flame retardant bamboo fiber reinforced polylactic acid composites regulated by interfacial phosphorus-silicon aerogel | 7 | 41 | [48] |
| 49 | Jia L.J. (2021) | Ultra-light poly(lactic acid)/SiO2 aerogel composite foam: A fully biodegradable and full life-cycle sustainable insulation material | 7 | 12 | [49] |
| 50 | Liu R. (2021) | Robust Silica–Polyimide Aerogel Blanket for Water-Proof and Flame-Retardant Self-Floating Artificial Island | 7 | 65 | [50] |
| 51 | Wang L. (2021) | Metal-graphene-synergized melamine aerogel with robust elasticity and flame-retardancy for thermal-insulated-packaging industry | 7 | 198 | [51] |
| 52 | Zheng X. (2021) | Improvement of Flame Retardancy of Polyurethane Foam Using DOPO-Immobilized Silica Aerogel | 6 | 60 | [52] |
| 53 | Niu Q. (2022a) | Interfacial silicon?nitrogen aerogel raise flame retardancy of bamboo fiber reinforced polylactic acid composites | 5 | 29 | [53] |

*S*. Table 4: List of the most involved organization involved in the relevant field based on documents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S/N | Organization | Documents | Citations | Mean citations | Total link strength |
| 1 | Department of Macromolecular Science and Engineering, Case Western Reserve University, Cleveland, Oh 44106-7202, United States | 5 | 445 | 89 | 893 |
| 2 | Institute of Nuclear Physics and Chemistry, China Academy of Engineering Physics, Mianyang, 621000, China | 5 | 320 | 64 | 739 |
| 3 | College of Biomass Science and Engineering, Sichuan University, Chengdu, 610065, China | 4 | 78 | 19.5 | 105 |
| 4 | College of Petrochemical Technology, Lanzhou University of Technology, Langongping Road 287, Lanzhou, 730050, China | 4 | 88 | 22 | 137 |
| 5 | Guangdong Provincial Key Laboratory of Functional Soft Condensed Matter, School of Materials and Energy, Guangdong University of Technology, Guangzhou, 510006, China | 4 | 267 | 66.75 | 247 |
| 6 | School of Mechanical and Manufacturing Engineering, University of New South Wales, Sydney, Nsw 2052, Australia | 4 | 219 | 54.75 | 759 |
| 7 | Center for Degradable and Flame-Retardant Polymeric Materials, National Engineering Laboratory of Eco-Friendly Polymeric Materials (Sichuan), State Key Laboratory of Polymer Materials Engineering, College of Chemistry, Sichuan University, Chengdu, 610064, China | 3 | 198 | 66 | 556 |
| 8 | Key Laboratory of Synthetic and Biological Colloids, Ministry of Education, School of Chemical and Material Engineering, Jiangnan University, Wuxi, 214122, China | 3 | 85 | 28 | 449 |
| 9 | Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, Ningbo, 315201, China | 3 | 16 | 5 | 259 |
| 10 | School of Petrochemical Engineering, Changzhou University, Changzhou, 213164, China | 3 | 13 | 4 | 329 |
| 11 | School of Resource and Safety Engineering, Central South University, Changsha, 410083, China | 3 | 41 | 13.6 | 703 |
| 12 | State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Materials Science and Engineering, Donghua University, Shanghai, 201620, China | 3 | 154 | 51.3 | 384 |
| 13 | State Key Laboratory of Chemical Engineering, College of Chemical and Biological Engineering, Zhejiang University, Hangzhou, 310027, China | 3 | 154 | 51.3 | 215 |
| 14 | State Key Laboratory of Fire Science, University of Science and Technology of China, 96 Jinzhai Road, Hefei, Anhui 230026, China | 3 | 102 | 34 | 366 |
| 15 | State Key Laboratory of Polymer Materials Engineering, Polymer Research Institute of Sichuan University, Chengdu, 610065, China | 3 | 64 | 21.3 | 197 |
| 16 | Academy of Scientific and Innovative Research (Acsir), Ghaziabad, 201002, India | 2 | 2 | 1 | 232 |
| 17 | Center for Degradable and Flame-Retardant Polymeric Materials, College of Chemistry, National Engineering Laboratory of Eco-Friendly Polymeric Materials (Sichuan), State Key Laboratory of Polymer Materials Engineering, Sichuan University, Chengdu, 610064, China | 2 | 107 | 53.5 | 469 |
| 18 | Civil and Infrastructure Engineering, School of Engineering, Rmit University, Melbourne, 3004, Australia | 2 | 16 | 8 | 522 |
| 19 | College of Chemistry and Materials Engineering, Zhejiang A&F University, Hangzhou, 311300, China | 2 | 21 | 10.5 | 16 |
| 20 | Department of Architecture and Civil Engineering, City University of Hong Kong, 88 Tat Chee Avenue, Kowloon, Hong Kong | 2 | 185 | 92.5 | 298 |
| 21 | Department of Materials and Environmental Chemistry, Stockholm University, Stockholm, 106 91, Sweden | 2 | 1063 | 531.5 | 215 |
| 22 | Department of Polymeric Materials and Engineering, School of Materials and Energy, Guangdong University of Technology, Guangzhou, 510006, China | 2 | 15 | 7.5 | 31 |
| 23 | Faculty of Engineering, China University of Geosciences (Wuhan), Hubei, Wuhan, 430074, China | 2 | 0 | 0 | 48 |
| 24 | Key Laboratory of Bio-Based Material Science and Technology, Ministry of Education, Northeast Forestry University, Harbin, 150040, China | 2 | 9 | 4.5 | 81 |
| 25 | Key Laboratory of Bioelectrochemistry and Environmental Analysis of Gansu Province, Lanzhou, 730070, China | 2 | 31 | 15.5 | 0 |
| 26 | Key Laboratory of Functional Geomaterials in China Nonmetallic Minerals Industry, China University of Geosciences, Wuhan, 430074, China | 2 | 0 | 0 | 172 |
| 27 | Key Laboratory of Rubber-Plastics, Ministry of Education, Shandong Provincial Key Laboratory of Rubber-Plastics, Qingdao University of Science & Technology, Qingdao, 266042, China | 2 | 2 | 1 | 211 |
| 28 | Key Laboratory of Rubber-Plastics, Ministry of Education/Shandong Provincial Key Laboratory of Rubber-Plastics, Qingdao University of Science & Technology, Qingdao City, Shandong 266042, China | 2 | 84 | 42 | 284 |
| 29 | Key Laboratory of Rubber–Plastics, Ministry of Education/Shandong Provincial Key Laboratory of Rubber–Plastics, Qingdao University of Science and Technology, Qingdao, 266042, China | 2 | 9 | 4.5 | 11 |
| 30 | Laboratory of Polymer Materials and Engineering, Ningbotech University, Ningbo, 315100, China | 2 | 11 | 5.5 | 194 |
| 31 | National Engineering Laboratory for Modern Silk, College of Textile and Clothing Engineering, Soochow University, Suzhou, 215123, China | 2 | 148 | 74 | 293 |
| 32 | National Key Laboratory of Science and Technology on Advanced Composites In Special Environments, Harbin Institute Of Technology, Harbin, 150001, China | 2 | 17 | 8.5 | 64 |
| 33 | Postdoctoral Research Station on Mechanics, College of Aerospace Science and Engineering, National University of Defense Technology, Hunan, Changsha, 410073, China | 2 | 3 | 1.5 | 26 |
| 34 | Research Institute of Chemical Defense, Beijing, 102205, China | 2 | 6 | 3 | 269 |
| 35 | School Of Economics and Management, Changsha University, Changsha, 410083, China | 2 | 16 | 8 | 522 |
| 36 | School Of Energy Resources and Safety, Anhui University Of Science and Technology, Huainan, Anhui 232001, China | 2 | 91 | 45.5 | 280 |
| 37 | School of Environmental & Safety Engineering, Changzhou University, Changzhou, 213164, China | 2 | 12 | 6 | 256 |
| 38 | School of Materials Science and Engineering, Nanyang Technological University, 50 Nanyang Avenue, Singapore, 639798, Singapore | 2 | 148 | 74 | 293 |
| 39 | School of Mechanical Engineering, University of Tehran, Tehran, Iran | 2 | 16 | 8 | 40 |
| 40 | School of New Energy and Materials, Southwest Petroleum University, Chengdu, 610500, China | 2 | 1 | 0.5 | 123 |
| 41 | School of Resources Engineering, Xi'an University of Architecture & Technology, Xi'an, 710055, China | 2 | 6 | 3 | 269 |
| 42 | School of Safety Science and Emergency Management, Wuhan University of Technology, Wuhan, China | 2 | 43 | 21.5 | 219 |
| 43 | School of Safety Science and Engineering, Xi'an University of Science & Technology, Xi'an, 710054, China | 2 | 6 | 3 | 269 |
| 44 | School of Science, Xihua University, Chengdu, Sichuan 610039, China | 2 | 62 | 31 | 332 |
| 45 | Shaanxi Province Key Laboratory of Papermaking Technology and Specialty Paper, National Demonstration Center for Experimental Light Chemistry Engineering Education, Shaanxi University of Science and Technology, Shaanxi, Xi'an, 710021, China | 2 | 12 | 6 | 194 |
| 46 | State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Materials Science and Engineering, Innovation Center for Textile Science and Technology, Donghua University, 2999 North Renmin Road, Shanghai, 201620, China | 2 | 148 | 74 | 283 |
| 47 | State Key Laboratory of Fire Science, University of Science and Technology of China, Hefei, Anhui 230027, China | 2 | 20 | 10 | 384 |
| 48 | State Key Laboratory of Polymer Materials Engineering, Polymer Research Institute, Sichuan University, Chengdu, 610065, China | 2 | 183 | 91.5 | 119 |
| 49 | The Collaborative Innovation Center for Eco-Friendly and Fire-Safety Polymeric Materials (Moe), National Engineering Laboratory of Eco-Friendly Polymeric Materials (Sichuan), State Key Laboratory of Polymer Materials Engineering, College of Chemistry, Sichuan University, Chengdu, 610064, China | 2 | 99 | 49.5 | 297 |

*S.* Table 5: List of the top influential countries based on the number of documents

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S/N | Country | Documents | Citations | Mean citations | Total link strength |
| 1 | China | 194 | 5932 | 30.57 | 16432 |
| 2 | United States | 20 | 991 | 49.55 | 4596 |
| 3 | Australia | 11 | 461 | 41.9 | 4177 |
| 4 | Canada | 9 | 209 | 23 | 2329 |
| 5 | India | 8 | 165 | 20.62 | 1166 |
| 6 | Sweden | 8 | 1520 | 190 | 2341 |
| 7 | Spain | 7 | 542 | 77.42 | 1972 |
| 8 | France | 6 | 68 | 11.3 | 1674 |
| 9 | South Korea | 6 | 124 | 20.6 | 812 |
| 10 | Singapore | 5 | 180 | 36 | 883 |
| 11 | Germany | 4 | 1215 | 303.75 | 1278 |
| 12 | Hong Kong | 4 | 293 | 73.25 | 1438 |
| 13 | Iran | 4 | 49 | 12.25 | 206 |
| 14 | Italy | 4 | 1136 | 284 | 1020 |
| 15 | United Kingdom | 4 | 56 | 14 | 809 |
| 16 | Poland | 3 | 81 | 27 | 32 |
| 17 | Switzerland | 3 | 198 | 66 | 887 |
| 18 | Viet Nam | 3 | 30 | 10 | 485 |
| 19 | Austria | 2 | 117 | 58.5 | 605 |
| 20 | Czech Republic | 2 | 49 | 24.5 | 304 |
| 21 | Finland | 2 | 95 | 47.5 | 712 |
| 22 | Slovenia | 2 | 990 | 495 | 676 |

*S.* Table 6: Full list of the top contributing authors in the relevant field of study.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S/N | Author | Documents | Citations | Mean citations | Total link strength |
| 1 | Wang X. | 18 | 687 | 38.2 | 11743 |
| 2 | Zhang X. | 15 | 442 | 29.5 | 8044 |
| 3 | Wang J. | 13 | 239 | 18.4 | 10404 |
| 4 | Zhang L. | 13 | 684 | 52.6 | 9613 |
| 5 | Li Z. | 10 | 142 | 14.2 | 8994 |
| 6 | Wang H. | 10 | 380 | 38 | 6501 |
| 7 | Wang Y. | 10 | 137 | 13.7 | 3998 |
| 8 | Wang L. | 9 | 177 | 19.7 | 8852 |
| 9 | Wang Y.-Z. | 9 | 583 | 64.8 | 10727 |
| 10 | Hu Y. | 8 | 107 | 13.4 | 7102 |
| 11 | Li H. | 8 | 176 | 22 | 5815 |
| 12 | Li X. | 8 | 80 | 10 | 5095 |
| 13 | Li Y. | 8 | 167 | 20.9 | 7302 |
| 14 | Zhang J. | 8 | 169 | 20.1 | 5370 |
| 15 | Zhang Z. | 8 | 159 | 19.9 | 4491 |
| 16 | Chen J. | 7 | 106 | 15.1 | 5437 |
| 17 | Chen Y. | 7 | 281 | 40.1 | 3967 |
| 18 | Shang K. | 7 | 393 | 56.1 | 8665 |
| 19 | Wang Z. | 7 | 60 | 9 | 3819 |
| 20 | Zhang S. | 7 | 34 | 5 | 5154 |
| 21 | Zhao H.-B. | 7 | 451 | 64.4 | 6753 |
| 22 | Chen H.-B. | 6 | 378 | 63 | 7448 |
| 23 | Cheng X. | 6 | 127 | 21.2 | 4676 |
| 24 | Huang J. | 6 | 263 | 43.8 | 3459 |
| 25 | Li A. | 6 | 132 | 22 | 5230 |
| 26 | Li M. | 6 | 332 | 55.3 | 5248 |
| 27 | Liu T. | 6 | 324 | 54 | 4618 |
| 28 | Liu Y. | 6 | 113 | 18.8 | 3907 |
| 29 | Schiraldi D.A. | 6 | 503 | 83.8 | 8433 |
| 30 | Xu J. | 6 | 106 | 17.7 | 2444 |
| 31 | Yang Y. | 6 | 176 | 29.3 | 4154 |
| 32 | Yuan B. | 6 | 220 | 36.7 | 4447 |
| 33 | Zhang Y. | 6 | 196 | 32.7 | 4171 |
| 34 | Zhou X. | 6 | 110 | 13.3 | 4667 |
| 35 | Zhu Z. | 6 | 132 | 22 | 5230 |
| 36 | Chen Z. | 5 | 253 | 50.6 | 3124 |
| 37 | Fan W. | 5 | 302 | 60.4 | 4320 |
| 38 | Huang Y. | 5 | 252 | 50.4 | 2652 |
| 39 | Li J. | 5 | 167 | 33.4 | 2498 |
| 40 | Liang W. | 5 | 109 | 21.8 | 3608 |
| 41 | Liao W. | 5 | 305 | 61 | 6445 |
| 42 | Liu L. | 5 | 129 | 26 | 2943 |
| 43 | Liu X. | 5 | 122 | 24.4 | 1695 |
| 44 | Sheng X. | 5 | 274 | 55 | 3434 |
| 45 | Sun H. | 5 | 109 | 21.8 | 3608 |
| 46 | Yang W. | 5 | 241 | 48.2 | 7471 |
| 47 | Yao C. | 5 | 42 | 8.4 | 2635 |
| 48 | Yue X. | 5 | 17 | 3.4 | 2328 |
| 49 | Zhao J. | 5 | 22 | 4.4 | 1891 |
| 50 | Chen M.-J. | 4 | 284 | 71 | 3454 |
| 51 | Deng S. | 4 | 72 | 18 | 1932 |
| 52 | Du X. | 4 | 89 | 22.3 | 840 |
| 53 | Gao B. | 4 | 22 | 5.5 | 1988 |
| 54 | Guo Z. | 4 | 19 | 5 | 1045 |
| 55 | He J. | 4 | 55 | 14 | 2676 |
| 56 | Li S. | 4 | 214 | 54 | 3225 |
| 57 | Liu C. | 4 | 29 | 7.3 | 1535 |
| 58 | Liu S. | 4 | 109 | 27.3 | 2377 |
| 59 | Lu H.-D. | 4 | 219 | 55 | 7175 |
| 60 | Luo Y. | 4 | 146 | 37 | 3616 |
| 61 | Ma X. | 4 | 64 | 16 | 1790 |
| 62 | Pan Y. | 4 | 81 | 20.3 | 3417 |
| 63 | Shi L. | 4 | 55 | 14 | 4315 |
| 64 | Sánchez-Soto M. | 4 | 112 | 28 | 4217 |
| 65 | Wang F. | 4 | 67 | 17 | 2791 |
| 66 | Wang S. | 4 | 121 | 30.3 | 2723 |
| 67 | Wang Y.-T. | 4 | 299 | 75 | 5170 |
| 68 | Wu L. | 4 | 48 | 12 | 4104 |
| 69 | Wu N. | 4 | 88 | 22 | 3943 |
| 70 | Wu Y. | 4 | 26 | 7 | 2905 |
| 71 | Yu J. | 4 | 141 | 35.3 | 2671 |
| 72 | Yu Z. | 4 | 46 | 11.5 | 1414 |
| 73 | Zhang H. | 4 | 52 | 13 | 3593 |
| 74 | Zhang Q. | 4 | 126 | 32 | 2425 |
| 75 | Zhao Y. | 4 | 63 | 16 | 1934 |
| 76 | Zhu J. | 4 | 96 | 24 | 3356 |
| 77 | Bergström L. | 3 | 1280 | 427 | 2404 |
| 78 | Carosio F. | 3 | 1114 | 371 | 1849 |
| 79 | Chan Q.N. | 3 | 206 | 69 | 3699 |
| 80 | Chen C. | 3 | 3 | 1 | 1975 |
| 81 | Chen L. | 3 | 90 | 30 | 1045 |
| 82 | Chen R. | 3 | 47 | 16 | 2002 |
| 83 | Chen S. | 3 | 45 | 15 | 2615 |
| 84 | Deng J. | 3 | 6 | 2 | 1016 |
| 85 | Deng Y. | 3 | 54 | 18 | 3289 |
| 86 | Du Z. | 3 | 67 | 22.3 | 967 |
| 87 | Fang Z. | 3 | 16 | 5.3 | 946 |
| 88 | Gong L. | 3 | 64 | 21.3 | 2853 |
| 89 | Guo X. | 3 | 2 | 0.7 | 2809 |
| 90 | Han Y. | 3 | 201 | 67 | 1187 |
| 91 | He X. | 3 | 35 | 11.7 | 1359 |
| 92 | Hong C. | 3 | 42 | 14 | 1228 |
| 93 | Hu Z. | 3 | 111 | 37 | 1386 |
| 94 | Huang H. | 3 | 14 | 4.7 | 1269 |
| 95 | Huang W. | 3 | 20 | 6.7 | 1515 |
| 96 | Jiang C. | 3 | 83 | 28 | 2714 |
| 97 | Jiang S. | 3 | 35 | 12 | 1438 |
| 98 | Jiang Y. | 3 | 0 | 0 | 1556 |
| 99 | Jin H. | 3 | 76 | 25.3 | 4208 |
| 100 | Li C. | 3 | 106 | 35.3 | 2417 |
| 101 | Li L. | 3 | 57 | 19 | 1489 |
| 102 | Liu Q. | 3 | 41 | 14 | 3651 |
| 103 | Lu X. | 3 | 38 | 13 | 1612 |
| 104 | Ma Y. | 3 | 52 | 17.3 | 2285 |
| 105 | Mao L. | 3 | 13 | 4.3 | 1890 |
| 106 | Niu F. | 3 | 87 | 29 | 2809 |
| 107 | Niu Q. | 3 | 16 | 5.3 | 946 |
| 108 | Shi H. | 3 | 13 | 4.3 | 1117 |
| 109 | Song L. | 3 | 102 | 34 | 2499 |
| 110 | Song P. | 3 | 356 | 119 | 1566 |
| 111 | Wang C. | 3 | 110 | 37 | 2121 |
| 112 | Wang W. | 3 | 26 | 9 | 2092 |
| 113 | Wu X. | 3 | 183 | 61 | 2703 |
| 114 | Wu Z. | 3 | 42 | 14 | 1565 |
| 115 | Xiao H. | 3 | 82 | 27.3 | 2447 |
| 116 | Xiao Y. | 3 | 7 | 2.3 | 1067 |
| 117 | Xie D. | 3 | 135 | 45 | 2074 |
| 118 | Xu L. | 3 | 105 | 35 | 2136 |
| 119 | Xu T. | 3 | 75 | 25 | 4233 |
| 120 | Xu X. | 3 | 106 | 35.3 | 1330 |
| 121 | Xue T. | 3 | 85 | 28.3 | 3066 |
| 122 | Yan Y. | 3 | 79 | 26.3 | 1066 |
| 123 | Yang F. | 3 | 54 | 18 | 2131 |
| 124 | Yang H. | 3 | 26 | 9 | 2903 |
| 125 | Yang Z. | 3 | 49 | 16.3 | 2593 |
| 126 | Yu B. | 3 | 315 | 105 | 3848 |
| 127 | Yuen A.C.Y. | 3 | 198 | 66 | 5957 |
| 128 | Yun S. | 3 | 76 | 25.3 | 4208 |
| 129 | Zhang C. | 3 | 26 | 9 | 1533 |
| 130 | Zhang W. | 3 | 1 | 0.3 | 995 |
| 131 | Zhao C. | 3 | 54 | 18 | 1861 |
| 132 | Zhou K. | 3 | 130 | 43.3 | 2140 |
| 133 | Zhou Z. | 3 | 26 | 9 | 1451 |
| 134 | Zhu S.-E. | 3 | 206 | 69 | 3699 |
| 135 | Antonietti M. | 2 | 1192 | 596 | 1062 |
| 136 | Apostolopoulou-Kalkavoura V. | 2 | 305 | 153 | 1906 |
| 137 | Baniassadi M. | 2 | 16 | 8 | 363 |
| 138 | Bo G. | 2 | 26 | 13 | 834 |
| 139 | Bourbigot S. | 2 | 1 | 0.5 | 2874 |
| 140 | Cao C. | 2 | 49 | 25 | 889 |
| 141 | Cao K. | 2 | 57 | 29 | 1446 |
| 142 | Cao M. | 2 | 99 | 50 | 2675 |
| 143 | Cao Y. | 2 | 103 | 51.5 | 915 |
| 144 | Chen H. | 2 | 23 | 11.5 | 1415 |
| 145 | Chen M. | 2 | 123 | 62 | 1428 |
| 146 | Chen W. | 2 | 20 | 10 | 1003 |
| 147 | Cheng J.-B. | 2 | 143 | 72 | 2070 |
| 148 | Cui C. | 2 | 20 | 10 | 1120 |
| 149 | Cui H. | 2 | 4 | 2 | 1790 |
| 150 | Cui Y. | 2 | 171 | 86 | 936 |
| 151 | Dai C. | 2 | 52 | 26 | 2755 |
| 152 | Deng X. | 2 | 16 | 8 | 2364 |
| 153 | Ding F. | 2 | 3 | 1.5 | 671 |
| 154 | Ding S. | 2 | 24 | 12 | 2210 |
| 155 | Ding Y. | 2 | 0 | 0 | 850 |
| 156 | Dong X. | 2 | 31 | 16 | 1185 |
| 157 | Fang Y. | 2 | 20 | 10 | 370 |
| 158 | Feng J. | 2 | 4 | 2 | 1253 |
| 159 | Gao W. | 2 | 217 | 109 | 1266 |
| 160 | Gao X. | 2 | 11 | 6 | 1375 |
| 161 | Geng J. | 2 | 77 | 39 | 1364 |
| 162 | Gong K. | 2 | 0 | 0 | 759 |
| 163 | Gong L.-X. | 2 | 57 | 28.5 | 1446 |
| 164 | Gu Y. | 2 | 52 | 26 | 2755 |
| 165 | Guan G. | 2 | 52 | 26 | 2755 |
| 166 | Guo L. | 2 | 105 | 52.5 | 1257 |
| 167 | Guo R. | 2 | 20 | 10 | 1120 |
| 168 | Hu T. | 2 | 75 | 38 | 3347 |
| 169 | Huang D. | 2 | 2 | 1 | 2442 |
| 170 | Huang S. | 2 | 36 | 18 | 2471 |
| 171 | Ji H. | 2 | 3 | 1.5 | 671 |
| 172 | Jia L. | 2 | 2 | 1 | 373 |
| 173 | Jiang F. | 2 | 17 | 9 | 1618 |
| 174 | Jiang H. | 2 | 143 | 72 | 1944 |
| 175 | Jiao Y. | 2 | 82 | 41 | 1380 |
| 176 | Kang A.-H. | 2 | 95 | 48 | 2865 |
| 177 | Lai X. | 2 | 24 | 12 | 1209 |
| 178 | Lai Y. | 2 | 148 | 74 | 1587 |
| 179 | Li B. | 2 | 3 | 1.5 | 1695 |
| 180 | Li D. | 2 | 4 | 2 | 1750 |
| 181 | Li K. | 2 | 4 | 2 | 613 |
| 182 | Li W. | 2 | 32 | 16 | 1210 |
| 183 | Li X.-L. | 2 | 62 | 31 | 1782 |
| 184 | Liang C. | 2 | 299 | 150 | 299 |
| 185 | Liao J. | 2 | 33 | 17 | 792 |
| 186 | Lin J. | 2 | 30 | 15 | 575 |
| 187 | Liu M. | 2 | 131 | 66 | 2270 |
| 188 | Liu P. | 2 | 61 | 31 | 1687 |
| 189 | Lu C. | 2 | 192 | 96 | 831 |
| 190 | Lu M. | 2 | 31 | 16 | 229 |
| 191 | Luo X. | 2 | 65 | 33 | 1123 |
| 192 | Ma C. | 2 | 88 | 44 | 1644 |
| 193 | Ma D. | 2 | 46 | 23 | 1655 |
| 194 | Mao Z. | 2 | 74 | 37 | 1800 |
| 195 | Mei Y. | 2 | 135 | 68 | 1603 |
| 196 | Mi Q. | 2 | 108 | 54 | 1919 |
| 197 | Nabipour H. | 2 | 91 | 46 | 1666 |
| 198 | Nie S. | 2 | 91 | 46 | 1666 |
| 199 | Niu H. | 2 | 22 | 11 | 967 |
| 200 | Niu M. | 2 | 3 | 1.5 | 609 |
| 201 | Niu Y. | 2 | 16 | 8 | 1301 |
| 202 | Ouyang C. | 2 | 2 | 1 | 2442 |
| 203 | Pan H. | 2 | 130 | 65 | 2292 |
| 204 | Ping P. | 2 | 44 | 22 | 2852 |
| 205 | Qian X. | 2 | 57 | 29 | 1312 |
| 206 | Qiang X. | 2 | 2 | 1 | 2442 |
| 207 | Qin R. | 2 | 3 | 1.5 | 609 |
| 208 | Qing Y. | 2 | 38 | 19 | 785 |
| 209 | Que Y. | 2 | 1 | 0.5 | 1625 |
| 210 | Ren E. | 2 | 20 | 10 | 1120 |
| 211 | Ren X. | 2 | 16 | 8 | 1074 |
| 212 | Riahipour R. | 2 | 16 | 8 | 363 |
| 213 | Shen J. | 2 | 78 | 39 | 1112 |
| 214 | Shen P. | 2 | 152 | 76 | 1811 |
| 215 | Shi J. | 2 | 27 | 14 | 339 |
| 216 | Shi S. | 2 | 17 | 9 | 633 |
| 217 | Shi Y. | 2 | 11 | 6 | 638 |
| 218 | Si J.-Y. | 2 | 185 | 93 | 2475 |
| 219 | Song R. | 2 | 108 | 54 | 1919 |
| 220 | Su M. | 2 | 16 | 8 | 1301 |
| 221 | Sui X. | 2 | 74 | 37 | 1800 |
| 222 | Sun G. | 2 | 89 | 45 | 1593 |
| 223 | Sun J. | 2 | 32 | 16 | 2931 |
| 224 | Sun Q. | 2 | 43 | 22 | 1270 |
| 225 | Tang L.-C. | 2 | 57 | 29 | 1446 |
| 226 | Tehrani M. | 2 | 16 | 8 | 363 |
| 227 | Tian J. | 2 | 34 | 17 | 1787 |
| 228 | Tian X. | 2 | 26 | 13 | 834 |
| 229 | Wang B. | 2 | 0 | 0 | 1463 |
| 230 | Wang L.-L. | 2 | 44 | 22 | 2852 |
| 231 | Wang M. | 2 | 1 | 0.5 | 1819 |
| 232 | Wang N.-N. | 2 | 183 | 92 | 2083 |
| 233 | Wang Q. | 2 | 31 | 16 | 542 |
| 234 | Wang R. | 2 | 42 | 21 | 1594 |
| 235 | Wei J. | 2 | 1 | 0.5 | 1625 |
| 236 | Weng M. | 2 | 104 | 52 | 765 |
| 237 | Wu H. | 2 | 122 | 61 | 1122 |
| 238 | Wu J. | 2 | 26 | 13 | 834 |
| 239 | Wu Q. | 2 | 0 | 0 | 783 |
| 240 | Wu S. | 2 | 36 | 18 | 1274 |
| 241 | Xia M. | 2 | 53 | 27 | 2866 |
| 242 | Xia Y. | 2 | 16 | 8 | 1153 |
| 243 | Xiang D. | 2 | 1 | 0.5 | 1625 |
| 244 | Xie H. | 2 | 89 | 45 | 1344 |
| 245 | Xie W. | 2 | 89 | 45 | 1826 |
| 246 | Xing Y. | 2 | 81 | 41 | 930 |
| 247 | Xu G. | 2 | 3 | 1.5 | 671 |
| 248 | Xu K. | 2 | 0 | 0 | 1429 |
| 249 | Xu Y. | 2 | 1 | 0.5 | 1437 |
| 250 | Xue B. | 2 | 3 | 1.5 | 609 |
| 251 | Yan M. | 2 | 50 | 25 | 2189 |
| 252 | Yang D. | 2 | 0 | 0 | 1277 |
| 253 | Yang L. | 2 | 81 | 41 | 864 |
| 254 | Yang M. | 2 | 0 | 0 | 740 |
| 255 | Ye D.-D. | 2 | 95 | 48 | 2865 |
| 256 | Yeoh G.-H. | 2 | 183 | 92 | 2083 |
| 257 | Yeoh G.H. | 2 | 36 | 18 | 5116 |
| 258 | Yin L. | 2 | 0 | 0 | 759 |
| 259 | Yu P. | 2 | 10 | 5 | 1161 |
| 260 | Yu Y. | 2 | 13 | 7 | 1419 |
| 261 | Zhang A.-N. | 2 | 143 | 72 | 2070 |
| 262 | Zhang G.-D. | 2 | 57 | 29 | 1446 |
| 263 | Zhang M. | 2 | 7 | 4 | 622 |
| 264 | Zhang T. | 2 | 37 | 19 | 1730 |
| 265 | Zhao H. | 2 | 9 | 5 | 1549 |
| 266 | Zhao X. | 2 | 51 | 26 | 2540 |
| 267 | Zhong Y. | 2 | 6 | 3 | 938 |
| 268 | Zhou J. | 2 | 0 | 0 | 850 |
| 269 | Zhu G. | 2 | 0 | 0 | 578 |
| 270 | Zhu Y. | 2 | 40 | 20 | 2212 |

*S.*Table 7: World Collaboration Map of Country Involvements “From” and “To”

|  |  |  |  |
| --- | --- | --- | --- |
| S/N | From | To | Frequency |
| 1 | Australia | France | 1 |
| 2 | Australia | Hong Kong | 2 |
| 3 | Canada | Finland | 1 |
| 4 | Canada | Sweden | 2 |
| 5 | Canada | Switzerland | 2 |
| 6 | China | Australia | 11 |
| 7 | China | Canada | 6 |
| 8 | China | France | 3 |
| 9 | China | Germany | 2 |
| 10 | China | Hong Kong | 4 |
| 11 | China | Italy | 1 |
| 12 | China | Japan | 1 |
| 13 | China | Korea | 1 |
| 14 | China | New Zealand | 1 |
| 15 | China | Saudi Arabia | 1 |
| 16 | China | Singapore | 3 |
| 17 | China | Spain | 4 |
| 18 | China | Sweden | 3 |
| 19 | China | Switzerland | 2 |
| 20 | China | United Kingdom | 4 |
| 21 | China | USA | 12 |
| 22 | Finland | Switzerland | 1 |
| 23 | India | Brazil | 1 |
| 24 | India | France | 1 |
| 25 | India | Germany | 1 |

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