

The background of the cover features a close-up photograph of aerogel, a highly translucent and insulating material. The aerogel is shown in a layered, geometric arrangement, with light passing through it, creating a play of colors from white to deep blue. The overall aesthetic is clean, modern, and technical.

# Aerogel Market Research Report

---

Date: January, 2024

Author: Brendan Jephcott

Prepared by:

**GOLDEN** DRAGON CAPITAL

## Table of Contents

Executive Summary .....	2
1.0 Introduction .....	10
1.1 Physical and Chemical Properties .....	11
1.2 Industry Development History .....	16
2.0 Aerogel Categories and Product Types .....	19
2.1 Oxide Aerogel Material .....	21
2.2 Carbon and Carbide Gel Aerogel Material .....	23
2.3 China Aerogel National Product Standard .....	24
3.0 Processing Methods .....	26
3.1 Drying Method .....	26
3.2 Sol-Gel Method .....	28
3.3 Post-Processing Modifications .....	28
4.0 Commercial Applications .....	31
4.1 Oil & Gas Industry .....	32
4.2 Automotive Industry .....	40
4.2.1 Lithium-ion Batteries Used In New Energy Vehicles .....	40
4.2.2 Automobiles .....	45
4.3 Construction Industry .....	46
4.3.1 Interior and Exterior Walls .....	48
4.3.2 Architectural Coating Material .....	51
4.3.3 Glass Industry .....	54
4.4 Military Industry .....	54
4.5 Aerospace Industry .....	56
4.6 Clothing Industry and Daily Life .....	57
4.7 Environmental Protection .....	58
4.7.1 Oil-spill Remediation and Desalination .....	58
4.7.2 Air and Liquid Filtration .....	59
4.8 Energy Storage .....	60
4.8.1 Hydrogen .....	60
4.8.2 Supercapacitors .....	60
4.8.3 Silicon Anode Material with Aerogel .....	62
4.8.4 Lithium-Sulfur Batteries with Aerogel .....	62
4.9 Other Applications .....	63
4.9.1 Solar Energy .....	63
4.9.2 Cold Chain Packaging .....	63
4.9.3 Pharmaceutical and Personal Care .....	65
4.9.4 EMI Shielding .....	65
4.9.6 Knudsen Pump .....	66

# GOLDEN DRAGON CAPITAL

4.9.7	Aerodynamic Antennas.....	66
5.0	Future Industry Development Goals .....	67
5.1	Processing Technology Advancements.....	68
5.1.1	Supercritical Drying Method.....	68
5.1.2	Atmospheric Pressure Processing Method.....	70
5.2	Supply of Silicon Raw Materials .....	71
5.2.1	Silicon Tetrachloride .....	71
5.2.2	Functional Silane .....	73
6.0	Competitive Landscape.....	83
6.1	Overseas Companies .....	83
6.1.1	Aspen Aerogel Inc.....	84
6.1.2	Cabot Corporation.....	88
6.1.3	Armaceil Jios Aerogels .....	90
6.1.4	Other Companies.....	92
6.2	China Companies .....	103
6.2.1	Guangdong Alison High-tech Co., Ltd.....	111
6.2.2	Sinochem Corporation .....	124
6.2.3	Pan Asian Microvent Tech (Jiangsu) Corporation.....	127
6.2.4	Jiangsu Huachang Chemical Co., Ltd.....	136
6.2.5	Huayang New Material Technology Group Co., Ltd.....	139
6.2.6	Jiangxi Hongbai New Materials Co., Ltd .....	142
6.5.7	Other Companies.....	143
7.0	Global Market Outlook .....	155
7.1	China Market Size .....	159
7.2	Global Aerogel EV Market Size .....	171
8.0	Chinese Academy of Sciences .....	173
	References.....	178
	Disclaimer .....	180

---

## GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
Telephone: +852 4647 0122  
All correspondence to Email: [bjepcott@goldendragoncapital.com](mailto:bjepcott@goldendragoncapital.com)  
Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)

## Table of Figures

Figure 1: SiO <sub>2</sub> aerogel block material (sample) .....	10
Figure 2: Aerogel microscopic image .....	10
Figure 3: Porous nature of aerogel material (illustrative) .....	12
Figure 4: Aerogel is the world's lightest solid material known to date .....	12
Figure 5: Three types of heat transfer methods.....	13
Figure 6: Aerogel material under direct heat .....	13
Figure 7: Thermal insulation properties of aerogel .....	14
Figure 8: Traditional thermal insulation material rock wool (left) and perlite (right).....	14
Figure 9: Tianwen-1 Lander (left), Zhurong Rover (right) .....	14
Figure 10: Aerogel physical and chemical properties .....	15
Figure 11: Comparison of aerogel and traditional thermal insulation material.....	15
Figure 12: Number of aerogel related patent applications filed in China .....	17
Figure 13: Types of aerogel material and related commercial applications.....	19
Figure 14: SiO <sub>2</sub> aerogel block material.....	21
Figure 15: Al <sub>2</sub> O <sub>3</sub> aerogel block material (sample).....	22
Figure 16: Integrated circuits using Al <sub>2</sub> O <sub>3</sub> aerogel block material.....	22
Figure 17: Integrated circuit using Al <sub>2</sub> O <sub>3</sub> aerogel materials.....	22
Figure 18: All carbon aerogel material .....	24
Figure 19: Silica aerogel drying method principal process flowsheet.....	26
Figure 20: Aerogel drying processing method (illustrative) .....	26
Figure 21: Aerogel fiberglass felt (left) and Aerogel ceramic fiber felt (right).....	28
Figure 22: Aerogel insulation felt (1) PET, (2) reinforced silica, and (3) protection layer .....	29
Figure 23: Aerogel thermal insulation fabric principal processing flowsheet .....	29
Figure 24: Aerogel commercial applications in the modern economy .....	31
Figure 25: Mainstream aerogel products and applications .....	31
Figure 26: Commercial applications of aerogel material (source: IDTechEx).....	32
Figure 27: Downstream market changes of aerogel (source: IDTechEx).....	32
Figure 28: Aerogel application in the oil & gas industry .....	34
Figure 29: Outside energy pipeline .....	34
Figure 30: Economic benefits of aerogel felt used in long-distance steam pipelines.....	35
Figure 31: Economic benefits of aerogel felt used in above-ground pipelines.....	35
Figure 32: Aerogel replaces traditional thermal insulation material for industrial pipelines.....	37
Figure 33: Comparison of aerogel with traditional thermal insulation used in pipelines.....	37
Figure 34: Steam pipe insulation comparison.....	37
Figure 35: Logistical savings for aerogel-based pipe insulation .....	38
Figure 36: Local portage of insulation materials .....	38
Figure 37: China annual petroleum refining capacity.....	39
Figure 38: Lithium-ion battery energy density technology development goals .....	40
Figure 39: Causes of new energy vehicle fires (2014-2019).....	40
Figure 40: Thermal runaway chain exothermic process in lithium-ion batteries .....	41
Figure 41: Principle of thermal insulation of aerogel use in lithium-ion batteries .....	41
Figure 42: China national product standard regarding EV battery safety requirements .....	42
Figure 43: Global ternary material annual production forecast (2016-2015E).....	43
Figure 44: SiO <sub>2</sub> aerogel glass fiber felt composite used in lithium-ion battery packs.....	44
Figure 45: Application of aerogel composites used in passenger cars .....	44
Figure 46: Market size potential of aerogel use in global new energy vehicle market.....	45
Figure 47: Using aerogel material to construct automotive firewalls .....	46
Figure 48: Aerogel flame retardant material used in passenger cars.....	46
Figure 49: Application of aerogel felt in the construction industry .....	47
Figure 50: Comparison of aerogel and traditional insulation used in construction.....	47
Figure 51: Aerogel thermal insulation and decorative integrated board .....	48
Figure 52: China classification of wall insulation materials .....	48
Figure 53: Aerogel felt applied as exterior wall insulation material .....	49
Figure 54: Aerogel application as floorboarding .....	49
Figure 55: Aerogel applied as interior wall insulation material .....	50
Figure 56: China annual housing completion area output.....	51
Figure 57: Global architectural coatings material demand (2015-2019).....	52
Figure 58: Coating material categories and commercial applications .....	52
Figure 59: Aerogel coating material product advantages.....	52
Figure 60: China paint product classifications (2018) .....	53
Figure 61: Aerogel applications in the military industry.....	54

# GOLDEN DRAGON CAPITAL

Figure 62: Aerogel tailor made for military conditions.....	55
Figure 63: Reduction of air from aerogel material .....	55
Figure 64: Conduction of heat flow from atmosphere changes.....	56
Figure 65: Aerogel applications in the aerospace industry .....	56
Figure 66: Comparison of aerogel and common clothing insulation materials .....	57
Figure 67: Thickness comparison of aerogel garments and down jackets .....	57
Figure 68: Primaloft insulation cotton fibers (left) and aerogel polyester fibers (right) .....	58
Figure 69: SiO <sub>2</sub> aerogel applied in water purification setting.....	58
Figure 70: SiO <sub>2</sub> Aerogel applied to a distillation column .....	59
Figure 71: Photocatalysts for hydrogen generation from water-methanol mixtures.....	60
Figure 72: Process for 3D printing a supercapacitor electrode with a graphene aerogel.....	62
Figure 73: Lithium-Sulfur battery with aerogel .....	62
Figure 74: Aspen Aerogel - Spaceloft used in solar panels .....	63
Figure 75: American Aerogel Inc cold chain customers.....	64
Figure 76: Aerogel industry chain .....	67
Figure 77: Average aerogel cash cost distribution.....	67
Figure 78: Supercritical fluid (conceptual) .....	68
Figure 79: Polysilicon and its by-product silicon tetrachloride (sample) .....	71
Figure 80: Silicon tetrachloride principal processing flowsheet.....	72
Figure 81: China annual polysilicon production output (2015-2020) .....	72
Figure 82: China polysilicon price (2015-2019) .....	73
Figure 83: Functional silane (sample) .....	73
Figure 84: Distribution of global functional silane consumption (2019) .....	74
Figure 85: Distribution of global functional silane production by country (2019).....	74
Figure 86: USA functional silane company annual production capacity.....	75
Figure 87: Distribution of global functional silane consumption .....	76
Figure 88: Distribution of functional silane production in China .....	76
Figure 89: China functional silane production and consumption (2011-2019).....	77
Figure 90: China functional silane imports and exports (2011-2019).....	77
Figure 91: China functional silane enterprise operating capacity rate (2011-2019).....	77
Figure 92: China functional silane export varieties (2018) .....	78
Figure 93: China silane exports varieties (2018) .....	78
Figure 94: China functional silane import varieties (2018) .....	79
Figure 95: China functional silane import varieties (2018) .....	79
Figure 96: Average cash cost distribution of aerogel production .....	80
Figure 97: Aerogel companies with different development lifecycles .....	84
Figure 98: Aspen Aerogel — sales distribution aerogel products .....	85
Figure 99: Aspen Aerogel — revenue and net profit (unit: x US\$10,000) .....	85
Figure 100: Aspen Aerogel — related aerogel patents.....	87
Figure 101: Comparison of R&D expenditure between aerogel companies.....	87
Figure 102: Cabot — product sales (US\$ millions).....	88
Figure 103: Cabot — product sales by region (2019) .....	88
Figure 104: Cabot — ENOVA® aerogel applied in coating material .....	89
Figure 105: Cabot — ThermalWrap® applied in insulation material .....	89
Figure 106: Cabot Aerogel product comparison .....	90
Figure 107: Armacell — advanced insulation sales .....	91
Figure 108: Armacell — advanced insulation application areas.....	91
Figure 109: JIOS AeroVa® — properties (left) and structure (right).....	92
Figure 110: JIOS AeroVa® — particle analysis (left) and applications (right).....	92
Figure 111: BASF SLENTEX®.....	93
Figure 112: Office in Barcelona, Spain.....	94
Figure 113: GEAT aerogel product series .....	94
Figure 114: Active Aerogels - thermal conductivity test .....	95
Figure 115: Active Aerogels – aerogel blankets .....	95
Figure 116: Aerogel UK Limited processing method .....	96
Figure 117: Aerogel UK Limited product specifications .....	96
Figure 118: Enersens Kwark® product .....	97
Figure 119: Enersens aerogel felt product series .....	98
Figure 120: Finesulight™ product (sample) .....	98
Figure 121: Silica aerogel as filler material.....	99
Figure 122: Finesulight™ and comparison.....	99
Figure 123: Finesulight™ temperature change on glass material.....	99
Figure 124: Finesulight™ applied to composite products .....	100

GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
Telephone: +852 4647 0122  
All correspondence to Email: [bjephcott@goldendragoncapital.com](mailto:bjephcott@goldendragoncapital.com)  
Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)

# GOLDEN DRAGON CAPITAL

Figure 125: Airloy Aerogel product series .....	100
Figure 126: Manze Group aerogel felt material .....	101
Figure 127: Average aerogel cash cost distribution .....	110
Figure 128: Sinochem aerogel project and related companies .....	124
Figure 129: Hualu New Materials — Aerogel production line.....	125
Figure 130: Pan Asian Microvent Tech — stock price (source: Bloomberg) .....	127
Figure 131: SiO <sub>2</sub> aerogel glass fiber felt composite material used in battery packs .....	127
Figure 132: Application of SiO <sub>2</sub> aerogel And ePTFE membrane composites.....	128
Figure 133: Aerogel ePTFE membrane composite material project summary .....	128
Figure 134: SiO <sub>2</sub> aerogel atmospheric pressure method processing flowsheet.....	129
Figure 135: Supercritical SiO <sub>2</sub> aerogel processing flowsheet .....	131
Figure 136: Aerogel and ePTFE membrane composite material processing flowsheet.....	132
Figure 137: SiO <sub>2</sub> aerogel and ePTFE membrane composite material (illustrative).....	133
Figure 138: Application of CMD in new energy battery packs.....	135
Figure 139: Huachang Chemical — stock price (source: Bloomberg).....	136
Figure 140: AP New Material production base, Henan Province, China .....	137
Figure 141: AP New Materials — aerogel product series .....	137
Figure 142: AP New Material — customers .....	138
Figure 143: Zhongning Technology — product series.....	139
Figure 144: Zhongning Technology — cooperative partners .....	139
Figure 145: Zhongning Technology — related aerogel patents .....	139
Figure 146: Huayang Group — Nanoporous SiO <sub>2</sub> aerogel powder stockpiled .....	140
Figure 147: Huayang Group — Nanoporous SiO <sub>2</sub> aerogel powder being sent to Japan .....	140
Figure 148: Hongbai New Materials — stock price (source: Bloomberg) .....	142
Figure 149: PRET stock price (source: Bloomberg) .....	143
Figure 150: Nano Technology Co., Ltd — office in Zhejiang Province, China.....	145
Figure 151: Nano Technology Co., Ltd — aerogel felt.....	145
Figure 152: Hebei Jinna Technology Co., Ltd — office in Hebei Province, China.....	146
Figure 153: Jinna Technology — aerogel product series.....	146
Figure 154: Sunano aerogel thermal insulation products .....	147
Figure 155: Luyang Headquarters, Zibo City, Shandong Province, China .....	149
Figure 156: Langfang production base, Dacheng County, Hebei Province .....	150
Figure 157: Langfang — product series .....	150
Figure 158: Yantuo — cooperative partners.....	150
Figure 159: Yantuo — aerogel product series.....	151
Figure 160: Tenanom — office and product series.....	151
Figure 161: CES Asia 2019 .....	152
Figure 162: Tenanom booth at CES Asia 2019.....	152
Figure 163: Kono Materials — aerogel product series.....	153
Figure 164: Cannano — cooperative partners.....	153
Figure 165: Cannano — aerogel product series.....	154
Figure 166: Municipal Government members visit Cannano production facilities .....	154
Figure 167: Growth of Aerogel in Thermal Insulation Market 2020-2025 (US\$ billion).....	155
Figure 168: Global aerogel industry market size forecast.....	156
Figure 169: Distribution of aerogel product categories in China .....	156
Figure 170: China silica aerogel industry market size forecast.....	157
Figure 171: China aerogel import and export volumes .....	157
Figure 172: Global aerogel thermal insulation material market size.....	158
Figure 173: Aerogel downstream demand structure forecast (2021 to 2026) .....	158
Figure 174: China Aerogel Materials and Products Output.....	159
Figure 175: China Aerogel Market Application (2019).....	159
Figure 176: China aerogel market demand forecast (2021-2030E) .....	161
Figure 177: Aerogel composite insulation scheme for pipelines .....	162
Figure 178: China Qinhuangdao thermal coal price (Q5500) CNY per tonne .....	164
Figure 179: Brent crude oil and natural gas price.....	164
Figure 180: Aerogel prevents thermal diffusion between cells and modules.....	166
Figure 181: Aerogel inserts are used for thermal insulation between cells .....	166
Figure 182: Total energy consumption of China's construction industry .....	168
Figure 183: Composition of traditional building insulation materials.....	168
Figure 184: China aerogel market demand forecast (2020 to 2025).....	170

GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
Telephone: +852 4647 0122  
All correspondence to Email: [bjephcott@goldendragoncapital.com](mailto:bjephcott@goldendragoncapital.com)  
Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)

## List of Tables

Table 1: Aerogel physical and chemical properties .....	11
Table 2: Aerogel Guinness World Record achievements .....	11
Table 3: Aerogel thermal insulation properties .....	13
Table 4: Carbon based aerogel material electrical properties .....	15
Table 5: China government related aerogel industry development policies .....	17
Table 6: Comparison of aerogel and traditional thermal insulation material .....	18
Table 7: Aerogel product categories and related commercial applications .....	19
Table 8: Aerogel commercial products and performance characteristics .....	20
Table 9: Aerogel product thermal conductivity requirements (GB/T 34336-2017) .....	24
Table 10: Nanoporous silica aerogel product technical requirements (Q/ZNKJ 001-2019) .....	25
Table 11: China aerogel felt product specifications (non-exhaustive) .....	25
Table 12: Comparison of aerogel drying processing methods .....	27
Table 13: Comparison of thermal insulation material after coating with aerogel .....	29
Table 14: Related aerogel composite material patents .....	30
Table 15: Aerogel felt material installation process .....	36
Table 16: Aerogel material in oil and gas application .....	36
Table 17: Temperature changes from using aerogel material .....	36
Table 18: Aerogel as pipeline insulation case studies .....	39
Table 19: Aerogel material application in battery thermal management .....	42
Table 20: Comparison of aerogel and traditional insulation used in EV batteries .....	43
Table 21: Market size potential of aerogel use in China new energy vehicle market .....	45
Table 22: Market size potential of aerogel use in global new energy vehicle market .....	45
Table 23: Aerogel composites performance in building insulation material .....	47
Table 24: Comparison of aerogel and common thermal insulation used in construction .....	48
Table 25: Related patents for aerogel coating material processing methods .....	53
Table 26: Aerogel composite glass commercial applications and functionality .....	54
Table 27: China policy guidance for developing its aerogel industry .....	68
Table 28: Aerogel technology standards used in China .....	68
Table 29: Comparison of two drying methods for aerogel production .....	69
Table 30: Aerogel drying processing method technology breakthroughs .....	69
Table 31: History of aerogel processing method technology breakthroughs .....	71
Table 32: Global major silane producers .....	80
Table 33: Inorganic silicon raw material cash costs .....	80
Table 34: Comparison of organic silicon sources and inorganic silicon sources .....	81
Table 35: Methyl orthosilicate and ethyl orthosilicate (silicone raw materials) .....	81
Table 36: Aspen Aerogel — product characteristics .....	86
Table 37: Aspen Aerogel — product information and customer information .....	86
Table 38: Cabot — aerogel product information and applications .....	90
Table 39: AJA — product information and applications .....	91
Table 40: SLENTIX product properties .....	93
Table 41: GEAT — product information and applications .....	94
Table 42: Blueshift Materials – aerogel product series .....	102
Table 43: Major China aerogel producers .....	106
Table 44: China aerogel enterprises and production capacity .....	106
Table 45: Major China aerogel companies and annual production capacity .....	107
Table 46: Technical routes and technical sources of mainstream aerogel companies .....	108
Table 47: Aerogel cash cost distribution .....	110
Table 48: Guangdong Alison Shareholders .....	111
Table 49: Guangdong Alison — product information and applications .....	111
Table 50: Guangdong Alison — aerogel product series .....	111
Table 51: Development History of Guangdong Alison .....	113
Table 52: Sinochem aerogel project summary .....	124
Table 53: Hualu New Materials equipment used in aerospace Wujiang aerogel .....	125
Table 54: Sinochem aerogel product development history .....	125
Table 55: Hualu New Materials — related aerogel patents .....	125
Table 56: Aerogel ePTFE membrane composite material project summary .....	128
Table 57: Supercritical SiO <sub>2</sub> aerogel material processing flowsheet .....	132
Table 58: Aerogel and ePTFE membrane composite material processing flowsheet .....	132
Table 59: Project raw material annual consumption .....	133
Table 60: Project main equipment used .....	133
Table 61: Pan-Asia micro-breathable gel product development history .....	134

GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
 Telephone: +852 4647 0122  
 All correspondence to Email: [bjephcott@goldendragoncapital.com](mailto:bjephcott@goldendragoncapital.com)  
 Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)

# GOLDEN DRAGON CAPITAL

Table 62: Pan Asian Microvent Tech (Jiangsu) Corporation — related aerogel patents .....	135
Table 63: AP New Materials — annual production .....	137
Table 64: AP New Materials — related aerogel patents .....	138
Table 65: Huayang Company aerogel development milestones .....	141
Table 66: Yangzhong New Materials — related aerogel patents .....	141
Table 67: Hongbai New Material — related aerogel patents .....	143
Table 68: Suzhou Zwierner Nanotechnology Co., Ltd — aerogel product series .....	148
Table 69: China aerogel market demand forecast (2021-2030E) .....	160
Table 70: Comparison between aerogel composite insulation and traditional insulation .....	162
Table 71: Investment in an aerogel composite insulation solution .....	163
Table 72: Aerogel insulation material has a long service life .....	163
Table 73: Calculation of the economic impact of energy prices on aerogel solutions .....	164
Table 74: China aerogel market demand for industrial pipelines (2017 to 2025) .....	165
Table 75: Global market space for aerogels for lithium battery sector (2018 to 2025) .....	167
Table 76: China Aerogel construction sector market forecast (2017 to 2025) .....	169
Table 77: China aerogel market demand forecast (2020 to 2025) .....	170
Table 78: China aerogel EV market demand forecast (2019-2025E) .....	172
Table 79: Global aerogel EV market demand forecast (2019-2025E) .....	172

---

GOLDEN DRAGON CAPITAL LIMITED

Address: 9QRC, 9 Queen's Road Central, Central, Hong Kong, China  
Telephone: +852 4647 0122  
All correspondence to Email: [bjephcott@goldendragoncapital.com](mailto:bjephcott@goldendragoncapital.com)  
Website: [www.goldendragoncapital.com](http://www.goldendragoncapital.com)