中国光伏行业
金刚线用钨丝市场研究

MARKET RESEARCH OF TUNGSTEN WIRE FOR DIAMOND WIRE SAW IN CHINA'S PHOTOVOLTAIC INDUSTRY

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作者简介

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BRIEF INTRODUCTION TO THE AUTHOR

As the 1st E-commerce company of Tungsten (W), Molybdenum (Mo), Rare Earth (RE) in China, China Tungsten Online Manu. & Sales (CTOMS) was founded in 1997 based on China's the 1st and top tungsten website www.chinatungsten.com. As its specialized design, professional manufacturing, excellent service and powerful information database, CTOMS is not only the most authoritative information source of Chinese and English information of W Mo and RE products globally, but also the best comprehensive application solution provider of W, Mo and RE, both chemical materials and machined products, such as tungsten oxide, metal, cemented carbide and heavy alloys.

CTOMS has been created more than 1 million web pages and WeChat information message of W, Mo and RE news, price and market research, analysis. The web news.chinatungsten.com, www.ctia.com.cn are the world's top index websites of tungsten which have received 1 billion visits from 1997.

The major business of CTOMS is to complete product design, R & D with customers and provide customers with processing and integration services. In the past 2 decades, it has provided more than 100,000 different types of W, Mo & RE products to more than 10,000 customers all over the world. Years experience and technology accumulation have laid a foundation for promoting the flexible and intelligent manufacturing of customized products.

The professional research articles and reports of CTOMS are written by Dr. Hanns and its marketing team. Dr. Hanns is an expert of the main market and technical research of CTOMS has been engaged in e-commerce and international trade of tungsten and molybdenum products, production and manufacturing of cemented carbide and high specific gravity tungsten alloy since the early 1990s. He is a well-known expert in e-commerce, tungsten product design, processing and Market Research of tungsten and molybdenum products in the industry with more than 30 years of experience.

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Market Potential for Tungsten Diamond Wire Saw

Brief introduction of "Market Research of Tungsten Wire for Diamond Wire Saw in China PV Industry"

Since 2022, China Tungsten and Hightech Materials Co. and Xiamen Tungsten Co. stocks have been all the way up through the trough, following a number of tungsten and cemented carbide manufacturers to climb. The reason for this is nothing more than the promising future market expectations of their announced investment project in market of tungsten base wire for diamond wire saw.

China Tungsten Online (CTOMS) has been specialized in the tungsten industry for decades and is well aware of the opportunity for tungsten wire for diamond wire saw. We have been established close relationships with partners who have tungsten wire capacity in the market since 2021. By virtue of this, producers can gain insight into tungsten wire production technology and control the cost. On the other hand, as a market professional, we provide the most valuable information for the industry.

Since this year, our social media team has been conducting in-depth studies on the photovoltaic (PV) industry, the diamond wire manufacturing field, the suitability of tungsten filaments and their production technology, costs and prices, etc., forming a nearly 100,000-word study of the market for tungsten wire for the PV industry, including standards for tungsten wire in China, the United States and Japan. This research draws heavily on information from the PV industry and the diamond wire industry, and makes in-depth reference to the technical development and current situation of tungsten wire companies to clarify the market logic of tungsten fund steel wire saw, analyze development trends and limitations, as well as consider the problems and risks facing the tungsten wire market.

Starting from tomorrow, we will update the content in our Wechat official account **"China Tungsten Online"** continuously. If you are interested in getting it in advance or require for the full report, please contact zhenghua@ctia.com.cn.

Tungsten wire as the base wire/core wire/nake wire/main body for diamond wire is of great interest of the market, which is spawned by the bottleneck encountered in the development of diamond wire industry. In a past period of time, (1) the world is calling for emission reduction and carbon neutrality, thus have given new energy with large opportunities, and the PV industry has seen a bright future after a long period of low. (2) The Russian-Ukrainian conflict brought the blockage of shipping and energy shortage crisis has further contributed to the rapid development of the solar industry. Such a multiple demand background makes the price of crystalline silicon materials continue to rise, any technology for sacing silicon material and link in the PV industry chain would bring huge

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profit margins. The industry could consider to reduce the amount of crystalline silicon material in several ways:

First of all, in recent years, silicon wafer cutting completely eliminated free abrasive wire saw technology, all using coated diamond wire cutting technology, significantly improving efficiency and corporate profits. LONGi Green Energy Technology Co. fully realized the diamond wire slicing in 2015, and the revenue of that year exceeded 5 billion yuan for the first time to reach 5.9 billion yuan, with a net profit of over $500 million, in 2019, it achieved revenue of 32.9 billion yuan and net income of 5.3 billion yuan.

Secondly, the arrangement of monocrystalline silicon is neat and the theoretical efficiency of photoelectric conversion high. The market share was only about 20% for a long time due to high production costs. While, diamond wire cutting technology has enabled the production cost of monocrystalline silicon wafers to drop significantly, and the market share of was up to nearly 90% in 2020, achieving a crushing replacement for polycrystalline silicon. On this basis, reducing diameter of crystalline silicon wire is one of the critical directions to control costs. Under required cutting efficiency, the strength of diamond base wire should not be reduced by wire diameter refinement. Thus, the change in material for base wire is a solid choice, therefor, PV cutting industry becomes savior of the tungsten wire industry.

Moreover, the direct consequence of the boom of the PV industry is that the price of crystalline silicon materials has risen sharply. LONGi Green Energy a subsidiary of LONGi, on June 30, the price of monocrystalline silicon wafer P-type M10 160um (182/247mm) was RMB 7.30 per wafer, compared to only RMB 6.86 last month. Monocrystalline silicon wafer P-type M6 160um (166/223mm) was 6.08 yuan per wafer (5.72 yuan, the former month). Monocrystalline silicon wafer P-type 158.75/223mm 160um was price 5.88 yuan / piece (5.52 yuan the former month). The prices for these silicon materials have been increased over 6%.

Under the rocketing of the silicon material price, lowing the thickness of silicon wafers to reduce the consumption is becoming the main direction to reduce cost. The reduction of wafer thickness also requires more refined diamond wire cutting and its equipment and technology. They all point to the diamond wire diameter, but the refinement of the carbon wire diameter has encountered a bottleneck. During the wafer cutting process, the wire speed must accelerate from static to 2,400 m/min (144 km/h) in 4 seconds, maintain it for 30 seconds and then decelerate to static again in 4 seconds. This is followed by a reciprocating motion to achieve high speed cutting. Such speed requirements require the carbon steel core wire reduced to 50um diameter, which meet a bottleneck: diamond grit, wire speed, cutting efficiency (wire breakage rate - flake rate), silicon crystal loss and silicon quality etc. To significantly increase efficiency, maintain a lower wire breakage rate, and keep the piece-out rate, it is necessary to change one of the decisive factors – base wire material. This has prompted the diamond wire industry to seek new alternative materials for base wire.

Finally, it was found that tungsten wire is richly endowed, since it has been developed for more than half a century with mature technology and sufficient material, and the capacity can be rapidly increased, so when there is potential business opportunity. Xiamen Tungsten Co. and China Tungsten and Hightech Materials Co. greatly invested to join the base wire of diamond market without hesitation. As far as the current situation is concerned, the main raw material of diamond wire core wire and diamond powder accounts for about 50% and 15% of the cost, the base wire is not the decisive factor of cutting effect, but the decisive carrier, also occupies the main cost. The actual production data research shows that the theoretical limit of carbon steel diameter is about 30um, the industry estimates that around 2023 after coated with diamond sand, the carbon steel diamond wire will reach the industrial limit of about 35-36um, and from the tensile strength data theoretical calculation, the industrial limit of the tungsten wire is expected to 24-25um. It draws a great prospect for solving the wire diameter limit.

Extrapolated from this, the tungsten wire-based diamond wire with its good toughness, high strength and hard-breaking could offset the weakness of higher cost than carbon steel-based wire (market price of 17 yuan/KM). Then, the carbon steel core wire would become history soon, **it will also bring new life to the traditional tungsten wire industry, play advantages of China's tungsten resources and tungsten wire processing, thus consolidating China's established quality and price advantage in the PV wafer position.**

The above is the basic content and logic of "Market Research of Tungsten Wire for Diamond Wire Saw in China's PV Industry", which we investigate and write meticulously. We will launch some of the contents from tomorrow onwards for all the respected followers of **"China Tungsten Online".**

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Chapter 2

Overview of Different Segments of Photovoltaic Industry

On September 22, 2020, President Xi sdeclared at the 7 the 75th General Assembly of the United Nations that "China aims to hit peak emissions before 2030 and for carbon neutrality by 2060". On December 12, 2020, General Secretary Xi emphasized at the Climate Summit that "by 2030, China's CO2 emissions per unit of GDP will be lowered by more than 65% from the 2005 level. The proportion of non-fossil energy in primary energy consumption will reach about 25%, forest accumulation will increase by 6 billion cubic meters compared to 2005, and the total installed capacity of wind and solar power will reach more than 1.2 billion kWs."

In order to achieve these goals, China is vigorously developing various renewable energy sources. Solar energy to its clean, safe, inexhaustible and other significant advantages, is a significant and fastest growing renewable energy in China. Amid the Paris Agreement entering into force on November 4, 2016, the global climate anomalies occured frequently in recent years, and the fossil energy is depleting and staying in high price, the renewable energy technologies evolved rapidly, and China's PV industry are forming a strong international competitiveness, no matter in the manufacturing scale, industrialization technology level, application market expansion, or industrial system construction we are among the global forefront.

Silicon Ore

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1. Overview of Photovoltaic Industry Chain

The PV industry chain involves silicon metal, polycrystalline silicon, polycrystalline silicon ingot, monocrystalline silicon rods, crystalline silicon slice manufacturing, crystalline silicon cell components, stands, inverters and PV power generation system design, installation and operation, etc.

The key players in each of the major production segments of the Chinese PV industry chain at present and the overview of the chain are shown in the table below. From the table we can find that in the crystalline silicon cutting, although diamond wire is a small part of the supplementary materials of the PV industry, it accommodates at least seven listed companies. It states the high intensity of competition and the speed of technological updates in the field of diamond wire. In the future, if tungsten wire becomes the main body for diamond wire, there will be new players entering this field, in the meantime soon there would be emerging competitors in the diamond wire saw industry.

Major production segments and key players in China's PV industry chain

According to the data, the market concentration of each segment in the PV industry chain from high to low is adhesive film > glass > diamond wire saw > tracking bracket > hot field > backsheet ≈ inverter > silver paste. The CR2 in 2020 are 66% for PV adhesive film (Hangzhou First Applied Material Co., Shanghai HIUV New Materials Co), 53% for PV glass (Xinyi Solar Holdings, Flat Glass Group Co.), 53% for diamond wire saw (Yangling Metron New Material Co., Hi-Tech Co.), 46% for mounts (NEXTracker (Singapore), Array Technologies (US)), 43% for PV hot field (Jinbo Co., Zhongtian Rocket), 43% for PV backsheet (Sailwood Technology, Shaanxi Zhongtian Rocket Technology Co.), 37% for inverter (Sungrow, Huawei), and 34% for front-side silver paste (Heraeus, DK Electronic

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Materials)

Diamond wire is currently a very concentrated field, but as the tungsten wire welcoming a large investment in capital to start production, if the producers of tungsten wire-based diamond wire master plating technology rapidly, add with their technology accumulation advantage, financial strength and monopoly position, the tungsten diamond wire saw is likely to break the current diamond wire.

While the production process of diamond wire saw is relatively short, the current core technology of electroplated diamond wire saw includes (1) main formula of plating solution, (2) diamond micropowder pretreatment, (3) micropowder surface treatment, (4) electroplating/coating process, (5) physical and chemical analysis technology, etc. There is no critical problem in technology, as tungsten wire diamond wire is a replacement of main body of dimond wire saw.

Our examination of the production of diamond wire saw and tungsten wire in this research reveals the possibility that (1) the complexity and difficulty of tungsten wire production is higher than that of diamond wire, and it is more difficult for potential competitors to enter the field and compete with it in a short period of time. (2) The existing tungsten wire production capacity has a monopoly advantage in the short term and it better to develop downstream market, while the reverse upward development of diamond wire will face the double technical problems and market risks of tungsten wire and/or diamond powder and diamond wire. (3) Diamond wire saw involves pulling process, in the case of increasing localization rate of production equipment, the initial investment has been reduced year by year, the single line machine upgrade to multi-line machine could double the expansion of production. At present, the single GW investment amount is within 10 million yuan, so the entrance for diamond wire saw production is not high.

2. Situation of Major Materials in Photovoltaic Industry Chain

According to the information of " China PV Industry Development Roadmap (2021 Edition)" published by the China Photovoltaic Industry Association (CPIA), after more than a decade of rapid development, China's PV industry ranks among the global leaders in manufacturing scale. Industrialization technology level, application market expansion, and industrial system construction, etc., and have together formed a strong international competitiveness, and achieving.

"The PV industry aim to achieve end-to-end independent control, and is expected to take the lead in becoming a strategic emerging industry, and the industry is also an important engine for promoting domestic energy revolution." The upstream and downstream segments of the PV industry chain include six major segments: polycrystalline silicon, silicon rods/ingots/wafers, batteries, modules, inverters, systems, etc. We focus on the crystalline silicon segment related to diamond wire cutting, in order to better understand the market structure of tungsten wire as the main body of dimond wire saw.

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2.1 Polycrystalline Silicon

In 2020, polycrystalline silicon reached 392,000 tons nationwide, up 14.6% year-on-year. Among them, the production of the top five enterprises accounted for 87.5% of China's total production, with four enterprises producing more than 50,000 tons. With the release of polycrystalline silicon enterprises' technical reform and capacity in 2021, the polycrystalline silicon production reached 505,000 tons, up 27.5% year-on-year. Of which, the TOP5 production accounts for 86.7% of the total domestic production, output of each company exceeds 50,000 tons. This year, with the release of polycrystalline silicon' technical reform and new production capacity, the production is expected to exceed 700,000 tons.

Monocrystalline Silicon (left) and Polycrystalline Silicon (right)

2.2 Silicon Wafers

Domestic silicon wafer production in 2020 would reach about 161.3GW, up 19.7% year-on-year. Among them, the top five companies accounted for 88.1% of China's total silicon wafer production, and their output exceeded 10GW. National silicon wafer production is expected to reach 181GW in 2021 as gaint companies accelerate their expansion. The actual national silicon wafer finished production in 2021 is 227GW, up 40.6% year-on-year. Among them, the top five companies account for 84% of the total domestic silicon wafer production, with output exceeding 10GW. With the accelerated expansion of leading companies, the national silicon wafer production is expected to exceed 293GW in 2022.

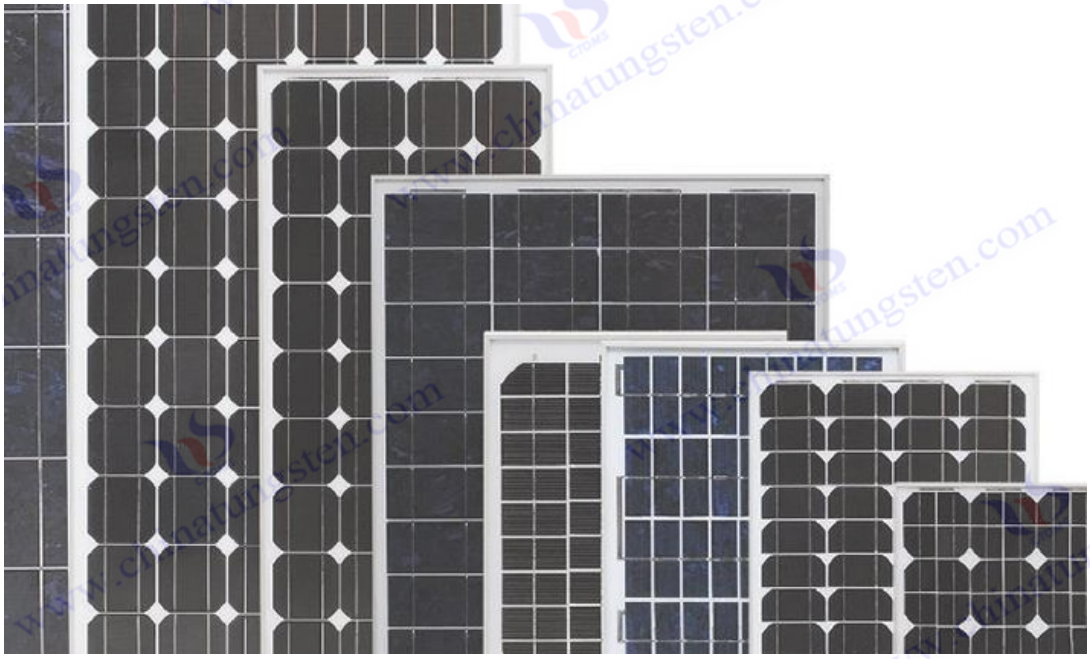
2.3 Crystalline silicon cells

In 2020, the national cell production will be about 134.8GW, up 22.2% year-on-year. Of these, the output of the top five enterprises accounts for 53.2% of the total cell production in China, with the top four manufacturers producing more than 10GW. The domestic cell production is expected to exceed 152GW in 2021, and the actual national cell production is

about 198GW, up 46.9% year-on-year. Among them, the production of the top five enterprises accounted for 53.9% of the total domestic cell production, with the top six enterprises producing more than 10GW. Domestic cell production is expected to exceed 261GW in 2022.

2.4 Crystalline Silicon Components

In 2020, domestic module production reached 124.6GW, up 26.4% year-on-year, dominated by crystalline silicon components. Among them, the output of the top five companies accounted for 55.1% of the total output, with the top three companies producing more than 10GW. The capacity is expected to exceed 145GW in 2021. The actual production reached 182GW in 2021, up 46.1% year-on-year, dominated by crystalline silicon components. Among them, the production of the top five enterprises accounted for 63.4% of the total domestic module production, with the top five enterprises producing more than 10GW. Production capacity is expected to exceed 233 GW in 2022.



Various specifications of solar panels made from polycrystalline silicon and monocrystalline silicon wafers

2.5 PV Market

In 2020, our country added 48.2GW of new PV grid-connected capacity, up 60.1% year-on-year. The cumulative grid-connected PV capacity reached 253GW, ranking first in the world for both new and cumulative installed capacity. Annual PV power generation of 260.5 billion kilowatt hours, accounting for about 3.5% of the country's total annual power generation. In 2021, the new PV installation exceeds 55GW and the cumulative installation reaches about 308GW.

The actual new PV grid-connected capacity in 2021 is 54.88GW, up 13.9% year-on-year; the

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cumulative PV grid-connected capacity reaches 308GW, with both the new and cumulative installed capacity being the first in the world. Annual PV power generation in 2021 is 325.9 billion KW, up 25.1% year-on-year, accounting for about 4.0% of the country's total annual power generation. It is expected that the new PV installation in 2022 will exceed 75GW, and the cumulative installation is expected to reach about 383GW.

In 2021, the large-scale production of p-type monocrystalline silicon cells used PERC technology, the average conversion efficiency reached 23.1%, compared with 2020, an increase of 0.3%, conversion efficiency of the advanced enterprises reaches 23.3%. 21.0% conversion efficiency of black polycrystalline silicon cells using PERC technology, an increase of 0.2% from 2020. Conventional black polycrystalline silicon cell efficiency is not strong motivation to improve the conversion efficiency of about 19.5% in 2021, only to improve 0.1%.

2.6 Power Consumption of Rodding Process for Silicon Wafer

Monocrystalline silicon rod pulling electricity consumption refers to the electricity consumed by direct pulling method to produce unit qualified monocrystalline silicon rods. The electricity consumption of rod pulling production can be reduced by improving the heat field, insulation performance, enhancing the automation and intelligence of equipment, and improving the continuous rod pulling technology.

In 2020, the average electricity consumption level for rod drawing is reduced to 26.2 kWh/kg-Si (square bar) from 29.1 kWh/kg-Si in 2019. It is expected to decrease to 21.4kWh/kg-Si by 2025.

Polycrystalline silicon reduction is a process in which silicon trichloride and hydrogen gas undergo a reduction reaction to produce high-purity silicon material, and its electricity consumption includes the electricity consumption during the process of silicon core preheating, deposition, insulation, and end gas exchange. In 2021, the proportion of single furnace dense material is maintained at 70%-80%, and the average reduction power consumption of polycrystalline silicon decreases by 6.1% from 2020 to 46kWh/kg-Si.

In the future, with the continuous optimization of gas ratios, the commissioning and stable production of large furnace models, and the trial of material by monocrystalline silicon manufacturers, the reduction power consumption will continue to show a decreasing trend, and is expected to drop to 42kWh/kg-Si by 2030.

2.7 Single Furnace Feed of Rodding Process

Single furnace feed of rodding process is the total charge of one crucible for multiple bar pulling production, where the crucible use time is one of the key factors. In 2020, single furnace feed is about 1,900 kg, a significant increase from 1,300 kg in 2019. With the continuous improvement of crucible making process and rod pulling technology as well as

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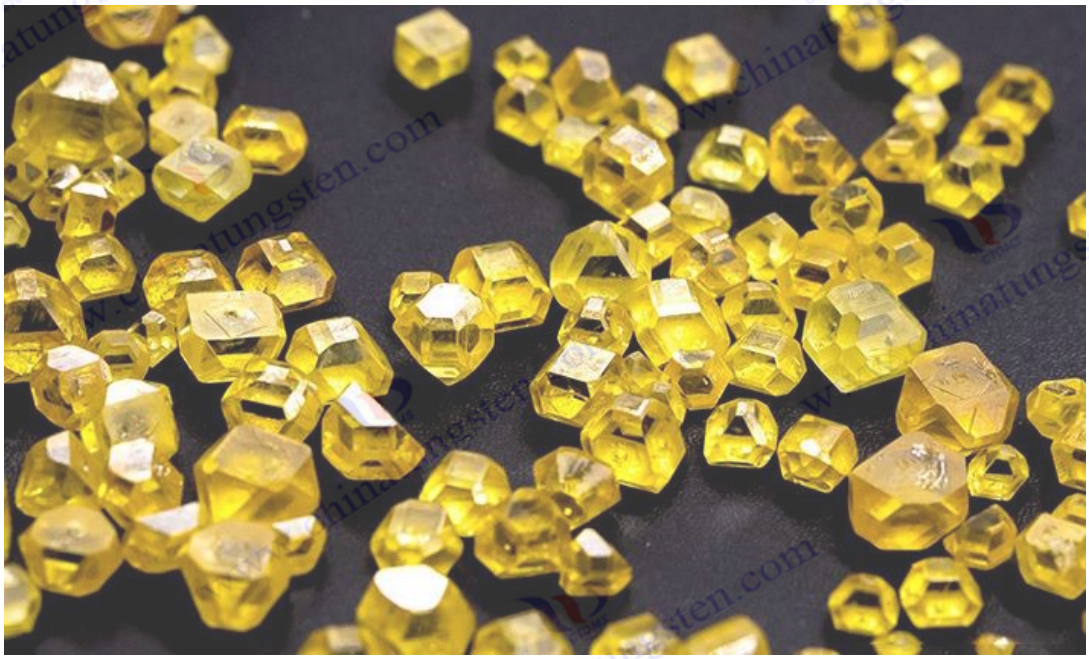
the optimization of crucible use, there is still more room for developing in feeding volume.



Particles of Artificial Diamond

2.8 Thickness of Silicon Wafer

Thinning is good for reducing silicon consumption and wafer costs, but it can affect fragmentation rates. The current slicing process could fully meet the requirments of thin wafers, but it should also meet the needs of the downstream cell and module manufacturing end. Wafer thickness has an impact on cell automation, yield, conversion efficiency, etc. In 2020, the average thickness of polycrystalline silicon wafers will be 180μm, the average thickness of P-type monocrystalline silicon wafers will be around 175μm, and the average thickness of N-type silicon wafers will be 168μm, basically the same as in 2019. The current average thickness of N-type silicon wafers is generally 175μm, for heterojunction cells it is about 150μm, and for IBC cells it is about 130μm. As wafer size increases, the rate of decline in wafer thickness will slow. In 2021, the average thickness of monocrystalline silicon is 178μm, due to the smaller demand, there is no incentive to continue thinning, so the thickness is forecast to remain unchanged at 170μm after 2025, but does not rule out the possibility of thinning in the future. The average thickness of p-type monocrystalline silicon wafers is around 170μm, down 5μm from 2020.

Currently, the average thickness of n-type silicon wafers for TOPCon cells is 165μm, and the thickness of silicon wafers for heterojunction cells is about 150μm, the wafer thickness is about 130μm for IBC cells and about 140μm for MWT cells.

2.9 Diameter of Base Wire of Diamond Wire Saw

In line with the cost of wafer production and the market requirement for thinner and

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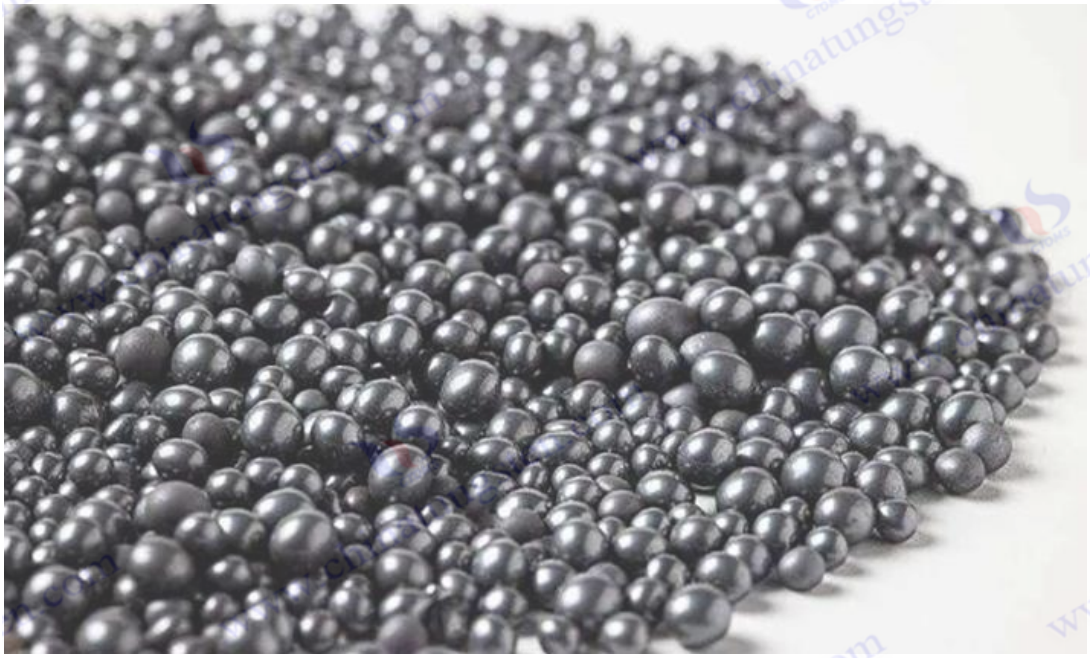
thinner wafers, the diameter of the base wire and the grinding media grit are related to the quality of the wafer cut and the amount of cutting losses: smaller wire diameter and particle size lead to lower cutting losses and production costs. In 2021, the diameter of core wire of diamond wire saw is 43-56μm, while in 2020 the figure is 48-57μm. By the time of the report, China Tungsten Online (CTOMS) had a detailed understanding of the market information. The diameter of tungsten wire used as a base wire in the market had dropped below 40μm, and mainstream tungsten wire manufacturers began to offer tungsten wire with a diameter of 35μm. CTOMS has been providing tungsten wire samples in the diameter range of 35-50μm for testing by relevant customers since 2022, and small volume deliveries are also concentrated in this diameter range.

Due to frequent defects and impurities in polycrystalline silicon wafers, thin wires are prone to breakage, so the diameter of polycrystalline silicon wafers is larger than that of monocrystalline wafers. However, in recent years the demand for polysilicon wafers has fallen sharply, and the decline in the diameter of polycrystalline silicon wafer cutting has slowed down. The general trend is that the diameter of monocrystalline silicon wafers is decreasing at a larger rate and is on a continuous downward trend. Due to the high rate of defects and impurities in polycrystalline silicon wafers, the fine wires are prone to breakage. Therefore, the diameter of the diamond wire used for polycrystalline silicon wafers is larger than that of monocrystalline silicon wafers, and as the demand for polycrystalline silicon wafers slows, the diameter of the diamond wire used for polycrystalline silicon wafers tends to decrease.



Cybrid's silicon particles

2.10 Output per Unit Square Rod/ Square Ingot under Diamond Wire Saw Cutting

As the diameter of the diamond wire saw reduces and the thickness of the wafer decreases,

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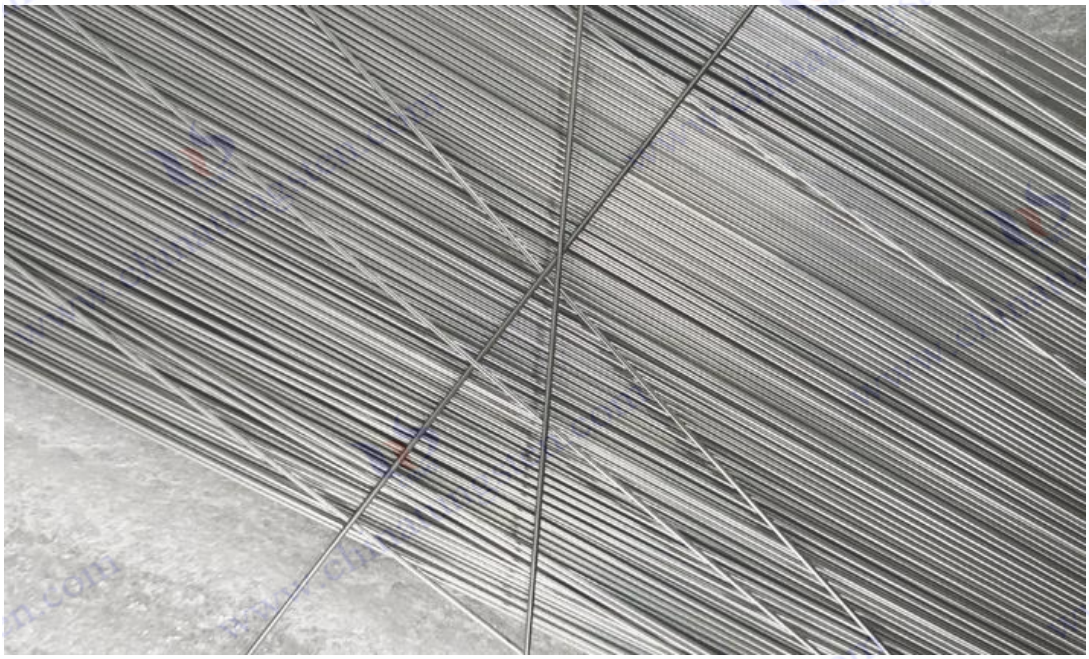
the amount of wafers produced per kilogram will increase for isometric square bars/square ingots. The output of P-type 166mm size is about 62 wafers per kilogram of monocrystalline silicon square bar and 58 wafers per kilogram of polycrystalline square ingot in 2020. In 2020, the output of P-type 158.75mm size is about 67 wafers per kilogram of monocrystalline silicon square bar. The output of P-type 182mm size is about 51 wafers per kg of monocrystalline silicon square bar, and the output of P-type 210mm size is about 38 wafers per kg of monocrystalline silicon square bar.

As the diameter of the diamond wire saw decreases and the thickness of the wafer decreases, the amount of wafers produced per kilogram will increase for isometric square bars/square ingots. In 2021, the output of p-type 166 mm size is about 64 wafers per kg ofmonocrystalline silicon square bar and 59 wafers per kg of polycrystalline square ingot. The output of P-type 158.75mm size is about 70 wafers per kg of monocrystalline square bar, the output of P-type 182mm size is about 53 wafers per kg of monocrystalline square bar, and the output of P-type 210mm size is about 40 wafers per kg of monocrystalline square bar.

Comparing the two grops of data, it is easy to find out that the thickness of silicon wafers continues to decline at the same time, the amount of wafers per kilogram of monocrystalline square bar out also still has a small increase in space, mainly due to the stability and improvement of technology, but also more and more companies switch to tungsten wire for main body of diamond wire saw.



Tungsten Wire

2.11 Market Share of Different Silicon Wafer Sizes

In 2021, there are various types of silicon wafer sizes in the market, including 156.75mm,

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157mm, 158.75mm, 166mm, 182mm, 210mm, etc., and each holds a certain market share. Among them, 158.75mm and 166mm size accounted for 50%, 156.75mm size declined 5%, and it is expected to fall in the future. 166mm is the largest size option that can be upgraded from the existing battery line and will therefore be the transition size for the last two years. Share of 182mm and 210mm sizes in 2021 grew rapidly to 45% from 4.5% in 2020, and its share will still expand in the future.

In 2021, the monocrystalline silicon wafer (p-type + n-type) market accounted for about 94.5%, with the p-type monocrystalline silicon wafer market growing to 90.4% from 86.9% in 2020 and the n-type monocrystalline silicon wafer about 4.1%. As the downstream demand for monocrystalline products increases, the market share of monocrystalline silicon wafers will further increase, and the share of n-type monocrystalline silicon wafers will continue to rise. The market share of polycrystalline silicon wafers decreases from 9.3% in 2020 to 5.2% in 2021, with a gradual downward trend in the future, but will still maintain a certain demand. The market share of ingot casting monocrystalline reached 0.3%, and the market share growth is not obvious.

As mentioned earlier, the diameter of the diamond wire saw in monocrystalline silicon wafers has decreased significantly in recent years, and polycrystalline silicon is more difficult to reduce its diameter, while the market for monocrystalline silicon for the mainstream of the product. Therefore, tungsten wire, which has better performance in smaller diameters, will be rapidly used in the processing of monocrystalline silicon. This has also revitalized the tungsten wire processing enterprises that originally entered the sunset industry in the past year, and have increased their investment in an attempt to gain a foothold in the PV battlefield.

3. Photovoltaic Industry Trends

In the context of global energy structure transformation and the promotion of "double carbon" and efforts to stabilize growth, China's green investment performance owns a promising future represented by the explosive growth of PV industry. Combined with PV power plant projects into the "grid parity" era, the rapid release of new installed demand for global PV, the demand for crystalline silicon wafers rises sharply.

According to the China Photovoltaic Industry Association (CPIA) data, the global PV new installed market capacity in 2021 is 170GW, up 31% year-on-year, and the national silicon wafer production is 227GW, up 40.7% year-on-year. Silicon wafers are the most concentrated part of the global PV industry chain, with production capacity mainly concentrated in China, which will account for 96% of global silicon wafer production in 2020.

CPIA's forecast for installed capacity in 2022 gives the market an optimistic message: a conservative 180 and optimistic 225 for the global market, close to the global PV market outlook for 2022 previously published in “Global PV”. Although CPIA has lowered its

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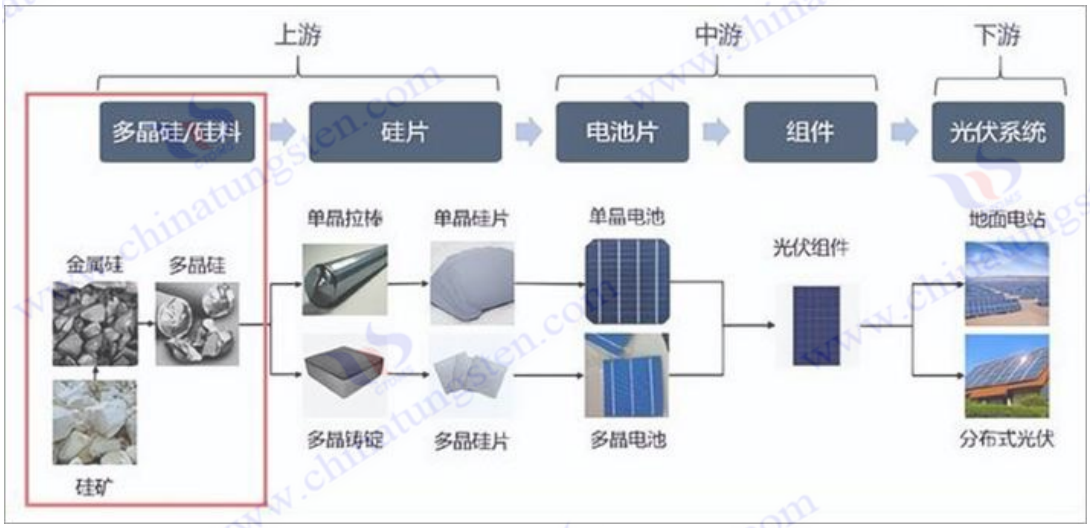
expectations for installed capacity in China this year, it expects a conservative 60 and optimistic 75GW for domestic market next year.



Structure of the photovoltaic industry (Credit: Shenwan Hongyuan)

CPIA expects that more and more companies involved in the PV power installation market to do distributed PV development, industry chain shift to low-carbon green energy regions, smart PV industry development opportunities, and vertical expansion, for increasing market value and business revenue of listed companies, non-PV companies in the "PV concept". That is, the PV industry is facing the trend of greening, low carbonization, intelligence, verticalization and cross-borderization.

Although the price of PV supply chain has remained firm so far in 2022 due to high raw material prices, the global demand for renewable energy such as PV continues to rise under the wave of energy transition and energy supply constraints caused by international conflicts.

According to customs data, China's exports of PV modules reached 14.4GW in May, up 95% year-on-year. Cumulative exports from January to May reached 63.4GW, up 102% year-on-year. Among them, Due to the Russian-Ukrainian conflict, European countries' demand on the energy transition is strong, in May, Europe imported 8.9GW PV modules from China, an increase of 146%, January-May cumulative imports of 33.3GW, an increase of 144%. In 2021, Europe's annual imports were only 40.9GW.

The global PV market has huge potential, with Germany planning to reach a cumulative 215GW of PV installations by 2030. According to Bloomberg, U.S. household PV market potential could reach 454GW. Cumulative installed capacity of household PV in the United States would triple by 2030. The Netherlands is expected to have 4GW of component demand in 2022; Spain will hold about 7.0GW of module demand in 2022.

The content and data in this chapter are mostly based on the China Photovoltaic Industry

Association (CPIA) website and the public content of the China PV Industry Development Roadmap (2021 Edition). The author of this article is grateful for the help provided by the public content of the CPIA website. Please contact the author for any copyrighted content such as infringement, or need for authorization. Thanks.

Note: The BOS (Balance of System) cost of PV refers to the system cost in addition to PV modules, which is mainly composed of the cost of major equipment such as inverters, brackets, cables, etc., as well as civil construction, installation works, project design, engineering acceptance and pre-associated costs.

Monocrystalline Silicon Material

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