Anti-Aging and Photovoltaic Property of Monocrystalline Silicon in Outdoor Fitness Equipment Use

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Abstract. Monocrystalline silicon is currently the most widely used photovoltaic material, but its application in outdoor fitness equipment is less researched. In this study, by simulating the operating conditions of outdoor fitness equipment and using xenon lamps to accelerate the environmental conditions, the efficiency of photovoltaic modules under different seasonal conditions was compared. The battery aging performance was tested under daily light for 12 hours, 8 hours and 4 hours. The results show that the selective design of photovoltaic modules can provide photovoltaic conversion efficiency under the premise of ensuring cell efficiency.

Keywords: Monocrystalline silicon, anti-aging, photovoltaic characteristics.

1. Introduction
According to the concept of intelligent fitness facilities, it is mainly aimed at the terminal layer of the Internet of Things, such as the intelligent perception ability of facility equipment, data collection, detection and control. Mobile phone scans QR code, swipe card, fingerprint recognition, face recognition, etc. Smart applications, such as smart fitness, are built on the basis of the Internet of Things gateway layer, computing and storage layer, and data and service integration layer[1]. This management standard is formulated from the technologies required for strong social management and public services. It can enable exercisers to get scientific and effective fitness guidance, intelligent fitness facilities are effectively managed, and the health and information of users are ensured safely. It further creates a good atmosphere for sports and national fitness, and promotes the integration of sports into life Economic and social benefits play a leading and supporting role [2].

With the advent of the new era, the basic needs of basic sports can no longer meet people's longing for a better life. The second generation of smart fitness path is to focus on "scientific sports" on the basis of "moving up". The second-generation smart fitness path includes a scientific fitness cloud service platform, collective quality monitoring, fitness path projects, popular fashion fitness projects, "expert" cloud guidance, scientific fitness knowledge popularization, and national fitness work promotion. It will be blind. Fitness is transformed into fitness under scientific guidance to meet the needs of people of different ages and different needs.

Users can display the exercise time, exercise times, exercise calories and animation demonstration of the use of mobile phone WeChat scan code or install mobile applet while exercising, to detect exercise calorie consumption, heart rate monitoring, based on statistical data Get an in-depth understanding of
the sports situation. It will transform the blind fitness exercises in the past through outdoor fitness equipment into a more purposeful and scientifically guided fitness method.

Health is an inevitable requirement for promoting people's all-round development, and it is a basic condition for economic and social development. The realization of national health and longevity is an important symbol of national prosperity and national rejuvenation and the common aspiration of people of all nationalities throughout the country. At present, both the government and the market are making strong efforts in the sports industry. The State Council issued the "National Fitness Program (2016-2020)" for the deployment of healthy China. Among them are the requirements for national fitness and public sports. It is planned that in 2020, the number of people who regularly participate in physical exercise will reach 435 million, and the per capita stadium area will reach 1.8 m². One of the important material foundations for meeting this goal is the construction and supply of public sports facilities. At the same time, with the continuous development of China's Internet of Things technology, modern information technologies such as cloud computing and big data have been combined with national fitness. Under the market trend, the group standard "Technical Requirements for Intelligent Fitness Facilities" has been released and implemented. However, it should be pointed out that as a long-term sports fitness facility used in the national fitness project, there are still many deficiencies in safety, management and maintenance, and user injuries occur from time to time. When the 5G era comes, how to urge the equipment management department to The normal maintenance and maintenance of intelligent equipment, cultivate a healthy and green lifestyle, and enhance the people's sense of well-being and gain. It is necessary to formulate a new era of intelligent public sports fitness facilities safety management norms, this norm will continue to meet the general public's health The higher level of demand is also an inevitable trend of the development of the times and is feasible. Since reform and opening up, from scratch, from backward to catching up, my country's photovoltaic industry has handed out proud transcripts. It is worth mentioning that, as China's photovoltaic technology has improved significantly, key components and components have basically been localized, and a complete industrial chain with international advanced levels has been constructed. The leap-forward development of the photovoltaic industry has greatly optimized the energy structure and made outstanding contributions to China's multiple goals of energy security, air pollution prevention, and low-carbon emission reduction.

Behind these dazzling achievements is the firm pace of the rapid development of my country's photovoltaic industry in the past 40 years of reform and opening up. Compared with other renewable energy sources such as hydropower and wind power, my country's photovoltaic industry started late. It was not until the 1980s that the solar energy industry and its related applications were included in the national scientific and technological research plan, and national policy support for the photovoltaic industry began to move from scientific research to specific practice. In 1997, the original National Development Planning Commission took the lead in formulating and implementing the "China Bright Project plan in response to the initiative proposed by the "World Solar Summit" held in Zimbabwe in 1996 to promote the "bright project" in areas without electricity worldwide. In 2009, the Ministry of Finance, the Ministry of Science and Technology, and the National Energy Administration jointly issued the " Notice on the Implementation of the Golden Sun Demonstration Project", and decided to comprehensively adopt financial subsidies, scientific and technological support, and market-driven methods to accelerate the industrialization and scale development of domestic photovoltaic power generation. In 2013, "Several Opinions on Promoting the Healthy Development of the Photovoltaic Industry" was officially issued. The era of photovoltaic power generation progress and electricity subsidies has given a strong shot to the development of my country's photovoltaic industry. On May 31, 2018, the three ministries and commissions of the National Development and Reform Commission, the Ministry of Finance, and the National Energy Administration issued the "Notice on Matters Related to Photovoltaic Power Generation in 2018", which kicked off the prelude to the online price of photovoltaic power generation. In the beginning of 2019, the National Development and Reform Commission and the National Energy Administration issued the "Notice on Actively Promoting Non-subsidized Affordable Access to Wind Power and Photovoltaic Power Generation", encouraging the
implementation of unsubsidized peace in areas with excellent resources, low construction costs, and good investment and market conditions Price online project.

2. Materials and equipment
The samples were cut into 70 mm×140 mm pieces to fit the sample holder, 5 parallel samples were measured. X65 xenon lamp artificial weathering test chamber made by Guangzhou Composite Materials Research Institute Co. Ltd. The lamps washed every 24 h to keep the lamps clean, and check the irradiation energy every washing interval. Tension machine made by Gotech testing machines Co. Ltd. The samples were tested for 12 h, 8 h and 4h, then check the anti-aging and photovoltaic property.

3. Results
Figure 1 shows the HC cycle figure of the 4h\8h\12h sunlight photovoltaic property. Generally, xenon lamps can destroy the colouring materials, lead the surface fading. From the result, it can clearly get that after the light radiation, the colour become duller. The test is under the rule of IEC 61730, the experiment order is accordance with the IEC 61215 and IEC 61646, the photovoltaic is categorizes as 2A, 3B and 4C. which should follow the MST 51~54 test.

![Figure 1. HC cycle figure of the 4h\8h\12h sunlight photovoltaic property](image)

The data transfer module is showed on Figure 2, the test take 7steps. 1) Disassemble and analyze each component of the smart component to evaluate the power consumption in various states. 2) Select the corresponding battery according to the accounting time. Taking Tianjin as an example, select the specifications of the solar cell polar plate based on historical sunshine data. 3) Collect data for purchased materials and monitor various parameters. 4) Adjust the component composition according to the actual data feedback and establish the model. 5) Apply the model to the actual product and check the actual operation. 6) Evaluate the product's life and safety, and comprehensively analyze the product's operating status. 7) Supplement and improve the systematic testing plan.
4. Discussion

At present, there is no unified standard requirement for second-generation equipment intelligent modules, and various products are produced by various enterprises. In the final analysis, the energy consumption of intelligent modules is still uncertain, and it is impossible to talk about the safety performance of products. This research focuses on intelligent fitness equipment and intelligent modules. It conducts research from two aspects of energy-saving and environmental protection design and electrical safety detection. The intelligent module is divided into input layers, which refers to components that convert other external energy sources into electrical energy, such as solar panels. The power layer is a component that provides electrical energy to the smart module, such as a lithium battery. The output layer allows users to get information, such as display speakers [3].

Before 2016, polysilicon controlled nearly 80% of the photovoltaic market by virtue of its cost advantage, and the promotion of PERC cells and the application of diamond wire slicing technology made the market share of monocrystalline continue to expand. The PERC battery adopts Al2O3 film to passivate the back surface, which can effectively reduce the back surface recombination, increase the open circuit voltage (VOC), increase the back surface reflection, increase the short circuit current (ISC), and ultimately improve the battery efficiency. In 2006, the passivation effect of the alumina dielectric film on the back of the P-type PERC began to attract everyone’s attention. In 2013, some manufacturers introduced more mature PERC technology. The conversion efficiency of single crystal PERC has surpassed other types of batteries, but the battery is still Did not solve the problem of high cost. The application and promotion of diamond wire slicing effectively solved the cost problem. Previously, silicon rod/silicon ingot slicing was basically completed by mortar cutting. In 2016, some single crystal companies launched diamond wire cutting applications, and then they developed in full swing.

Compared with traditional mortar cutting, the advantages of diamond wire cutting are mainly reflected in two aspects: the reduction of silicon consumption, because there are more diamonds that can participate in effective cutting by consolidation, the coating is smaller than the mortar mixture, the knife There are also fewer seam losses; the efficiency is greatly improved, the hardness of the diamond wire material is higher (the diamond hardness is higher than that of silicon carbide), and the cutting line speed is fast. In addition, the wire breakage rate of diamond wire cutting wear is very low. Finally, the cutting efficiency is improved, and the cost of a single piece is reduced. The single crystal has a consistent lattice sequence and the same crystal plane orientation, which is more suitable for diamond wire cutting. Therefore, after the introduction of diamond wire cutting, the cost of single crystal silicon has dropped rapidly, while polycrystalline silicon was only introduced in 2017. And the cost reduction is not as obvious as single crystal.
In the past few decades, solar photovoltaics have greatly improved in terms of efficiency and power generation. In 2018, polycrystalline photovoltaic efficiency reached 17%, and monocrystalline photovoltaic efficiency reached 18%. This growth trend is expected to continue until 2030. However, with the growth of the global photovoltaic market, the need to prevent panel degradation and manage a large number of decommissioned photovoltaic panels has also been carried out with the practice of circular economy. This includes innovative and alternative methods to reduce material use and component degradation, as well as reuse technology at the end of its useful life and increase photovoltaic panel recycling. Technical solutions and a market environment that supports the development of photovoltaics are the basis for preparing for the continued increase in the proportion of solar photovoltaic grid-connected in the future. In order to effectively manage large-scale intermittent renewable energy, the flexibility of all sectors of the energy system must be utilized. This includes from power generation to transmission and distribution systems, storage (electricity and heat), and the gradual increase in energy demand flexibility (demand-side management and departmental coupling).

Various signs indicate that the energy transition can bring huge socio-economic benefits. By 2050, the solar industry will employ more than 18 million people (of which 14 million will be employed in solar photovoltaics), four times higher than the 4.4 million jobs in 2018 (solar photovoltaics 3.6 million). However, in order to maximize the results of the energy transition, a comprehensive policy framework is particularly necessary. The deployment strategy needs to be coordinated with the grid connection and support strategy. Under the supportive policy framework, special emphasis needs to be placed on industrial, financial, educational, and skills policies to maximize the benefits of transformation. Education and skills policies can help the workforce acquire sufficient skills and increase local employment opportunities. Similarly, based on the local supply chain, sound industrial policies can support the development of the solar photovoltaic industry by using existing economic activities and promote income and employment growth.

In addition, the report pointed out that the release of the huge potential of solar photovoltaics is essential for achieving climate goals. This goal can only be achieved by removing current obstacles in different areas (policy, market and economy, technology, regulation, politics and society). Grid connection and grid flexibility, economies of scale, access to capital, lack of relevant standards and quality assurance measures, and consumer awareness are the main obstacles that may hinder the deployment of solar photovoltaic power generation capacity in the next 30 years. Eliminate existing obstacles through a series of supportive policies and implementation measures (including innovative business models), and at the same time, the development of new financial instruments is essential to facilitate the deployment of solar photovoltaic power generation capacity in the future, so as to achieve low-carbon, sustainable Future energy transformation.

By optimizing the matching relationship between the input layer (solar panel) and the power layer (battery), the power layer (battery) and the output layer (display screen), first disassemble and analyze each component of the output layer, and select the corresponding one by calculation Input layer and power layer, through actual experiments, obtain first-hand data, and carry out feedback analysis and summary. Optimize the structure of the output layer components, and at the same time systematically integrate the power layer and the input layer, and finally get a configuration that ensures low energy consumption and long life under the normal operation of the device. On this basis, through various detection methods, the detection and evaluation in various environments, such as temperature and weather, are summarized, and the detection scheme suitable for the new second-generation fitness equipment is summarized.

Different from traditional fitness equipment, the second-generation smart equipment is equipped with a sensor module, which can calculate the exerciser's exercise time, frequency, mileage, calorie consumption, etc. After the citizens finish their exercise, they can learn about relevant sports information through the voice prompt broadcast system. The athletes are informed of the time and effect through voice broadcasts. At the same time, the fitness equipment is equipped with a USB interface. People can charge their mobile phones while exercising. There are lights at night and 24 hours of exercise. It can be said that the second-generation fitness equipment is a product of the new era that meets people's
needs. The research and optimization of the intelligent module of the second-generation equipment is the key core technology to ensure that the second-generation equipment can promote national fitness and scientific fitness [4,5].

At the end of 2019, the General Sports Department of the State Sports General Administration conducted a tens of millions of "National Sports Administration 2019 Sports Park Facilities (Second Generation Outdoor Fitness Equipment) Procurement" bidding project, all well-known domestic fitness equipment manufacturers bid on the spot, and each product There are many kinds of smart modules. Some solar panels only play a role in the landscape. The solar panels and batteries and the functional power consumption do not match, causing problems such as unsatisfactory functions and shortened battery life. The price of a set of second-generation fitness equipment is nearly ten thousand yuan, and the core intelligent module is an electronic device, which is unreasonable in design and vulnerable to damage when used outdoors[6~8]. Optimized configuration of intelligent modules can increase the service life of products, reduce the production costs of enterprises, and bring intuitive economic benefits to production enterprises. This project is the first inspection and research on this content in the industry. While bringing economic benefits to the enterprise, it will also bring good economic benefits to our hospital. If this project can be promoted in the industry, it can obtain hundreds of thousands of business income for the department.

5. Conclusion
Studies have shown that monocrystalline silicon photovoltaic cells are suitable for photovoltaic components of outdoor fitness equipment and can work normally under different lighting conditions and different environmental conditions. When there is pollution attached to its surface, there will be hot spot effect, but it will not affect its service life.

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