

# Study on the Effect of Patentee Types and the Patent Location on the Patent Maintenance Time of SiC Ceramics

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**Abstract.** The development of SiC ceramic technology reflects the development of modern material technology. At present in China, the invention patent is the main type of technology patents of SiC ceramics, and the patentees are mainly universities and scientific research institutes. However, it is discovered that the enterprise invention patents have the longest average maintenance time. In addition, the number of invention patents in Zhejiang province ranks the first in China, but the average patent maintenance time in Beijing and Shanghai is relatively longer.

## 1. Introduction

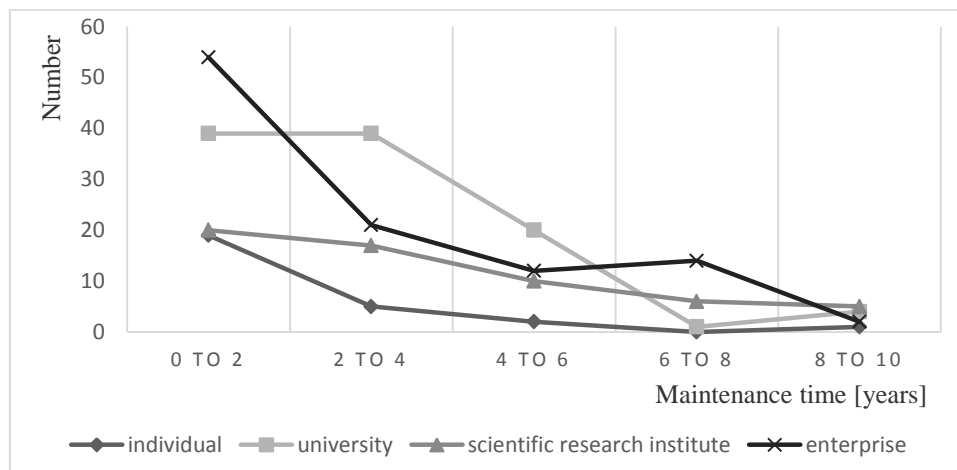
SiC ceramic material is a type of new material based on the technology of traditional inorganic materials. Because of its excellent properties of high strength, high hardness, corrosion resistance and high temperature resistance, SiC ceramics have been widely used in petrochemical industry, metallurgical machinery, aerospace, and microelectronics, automobile, steel and other fields [1-4]. Since 1980s, China has been developing SiC ceramic fiber technology and other technologies. After entering the 21st century, China has accelerated its pace of development, as a result, related technology patents have begun to emerge. According to the data of the China Intellectual Property Office, as of April 20<sup>th</sup> 2017, the number of patents on SiC ceramic technology has reached 1,657, and the number of authorized patents has reached 652.

Patents are one of the important indicators of the independent innovation output and commercial value in public policy [5], and the number of patents is widely used to evaluate innovation output [6]. Since patent maintenance time is an important indicator of the patent quality and the development degree in the technical field to which it belongs, longer patent maintenance time indicates higher expected revenues and reflects stronger technological competitiveness and higher patent quality [7]. Hence, in this paper, the SiC ceramics patent maintenance time and possible influencing factors are analyzed to explore the development and application of SiC ceramic technology in China.

## 2. Analysis of the relationship between patentee types and patent maintenance time in SiC ceramic field

As the existing data shows, the proportion of invention patents in the field of SiC ceramics is relatively larger, and its patent maintenance time is relatively longer. So the invention patents of SiC ceramics are analyzed as below in Figure 1 to find out the impact of the patentee types on the maintenance time.





**Figure 1.** The Maintenance time of Valid Invention Patents on SiC Ceramics held by Individuals, Universities, Scientific Research Institutes and Enterprises.

From the available data, it can be found that the number of valid invention patents held by different patentees is 191 for universities, 105 for enterprises, 67 for scientific research institutes, 37 for individuals and 2 for organizations. It can also be seen from Figure 1 that the number of SiC ceramics invalid invention patents held by the four types of patentees shows a trend of decrease with the increase of patent maintenance time.

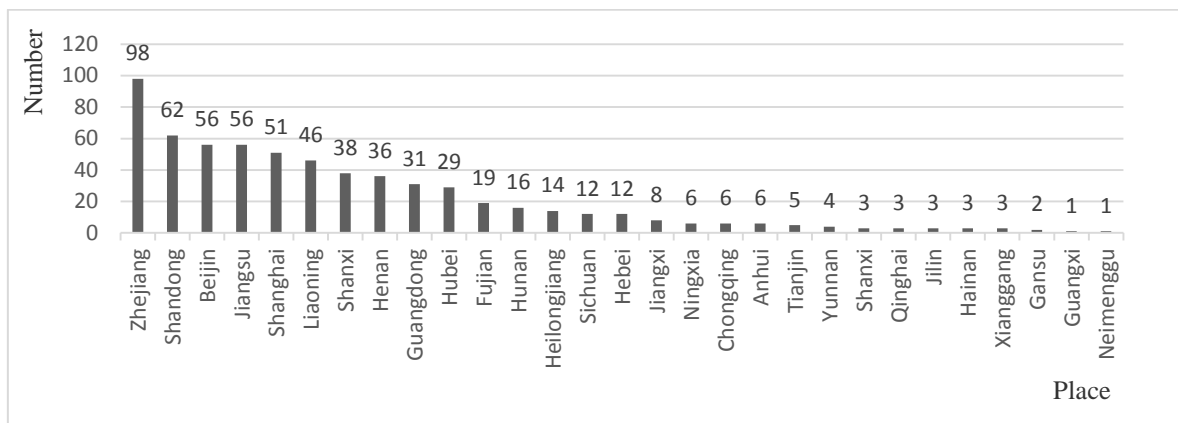
For the invalid invention patents held by universities, although the longest maintenance time is 4,916 days, the average maintenance time is only 1,436 days. The patent invalidity is basically due to the unpaid annual patent fees. Besides, the short validity of patents held by universities is mainly caused by the inability to turn the patents into actual profits, which fails to guarantee the patentees to continue to protect his/her, patent rights. The average maintenance time of the invalid invention patents held by scientific research institutes is basically the same as those held by universities. The reason may be that the commercial scale of patents held by universities and scientific research institutes is not wide enough, and there is still room for improvement in the transformation from SiC ceramic technology patents to related products in China.

The maintenance time of the invalid invention patents held by enterprise is the longest compared with other types of patentees, as enterprises can utilize the patents for commercial and industrial production. It is necessary to pay the prescribed patent holding fees for patentees to maintain their patent right, and the enterprise is more likely to be able to pay the patent fees and earn more profits from the patents, so its overall maintenance time will be longer.

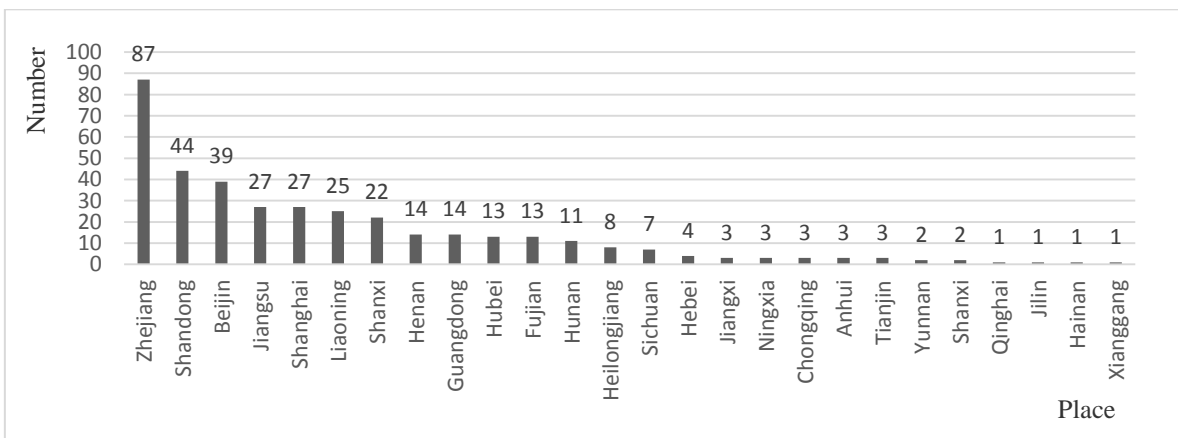
The number of individuals' invention patents on SiC ceramics is the least among the four types of patentees, but the average maintenance time of invalid patents is 2,073 days. It is speculated that the majority of individual patentees are in partnership with the enterprises so as to prolong the patent validity time by means of patent transfer, patent licensing, etc. However, at present, transferred patents and licensed patents account for only about 8.9% of all patents. In this sense, the patents on SiC ceramics in China are still in an immature stage, and further research and wider market application are needed. In addition, different patentees have different attitudes towards patent utilization and maintenance [8], and the differences in patent maintenance time are closely related to patentees' own characteristics.

### 3. Influence of SiC ceramics patent location on patent maintenance time

Generally speaking, there exists a strong relationship between the patent location and the number of patents, which can be explained by regional differences in research levels and related policies.



**Figure 2.** Regional Distribution of SiC Ceramics Patents.



**Figure 3.** Regional Distribution of SiC Ceramics Invention Patents.

From Figure 2 and Figure 3, it can be seen that the region with the largest number of patents and invention patents is Zhejiang province, and its average invalid patent duration is 1,429 days. The number of invalid invention patents held by Ningbo University accounts for about 48.3% of the total patent number in Zhejiang province.

At the same time, Zhejiang province has the longest maintenance time of valid invention patents at present, which is about 2,969 days. Ningbo University hardly appears as the patentee in this category, and the patentee types show the trend of diversification. The proportion of enterprises as owners of patents has risen significantly to 55%, which indicates that the technology of SiC ceramics in Zhejiang province is gradually changing from the stage of academic experiment to the stage of technical application.

For Beijing and Shanghai, the longest maintenance time of valid invention patents is 3,536 days in Shanghai and 3,228 days in Beijing, both higher than that in other regions. The major SiC ceramic patentees in Beijing and Shanghai are scientific research institutes and universities instead of enterprises, which seems to be in conflict with the above conclusion that invention patents need to extend the validity time through commercialization. However, in fact, the SiC ceramic patentees in various regions were mainly universities and scientific research institutes in the initial stage in China; they were usually the pioneering practitioners of technology research because of their advantages in scientific research. The relatively longer maintenance time of non-enterprise patentees in regions such as Beijing and Shanghai may be related to the higher technological level in Beijing and Shanghai as well as differences in economic strength and the ability to maintain patent rights. Economically developed regions are more likely to conduct timely transformation of technology into products and actual profits.

#### 4. Summary

The number of patents in the field of SiC ceramic technology in China has been increasing in the past decades. Among them, the number of invention patents is the largest, and all the patent maintenance time is generally shorter than the legal protection period. Judging from existing statistics, the types of patentees in China are mainly universities and scientific research institutes. This situation may be related to the incentive mechanism of technical innovation and scientific research in China's universities, which directly promotes the increase in the number of patent applications in universities<sup>[9]</sup>. Enterprises have the longest average invention patent maintenance time. The degree of commercialization of patents has an important influence on the validity time of patents, which also reflects the fact that the development of SiC ceramic technology in China is still in the experimental stage, and the increase in the number of enterprise patentees is also a manifestation of the enterprise's continued promotion of commercial application.

In recent years, with the arrival of era of knowledge-based economy, enterprises have been paying more and more attention to and relying more and more on science and technology, but their present innovation ability cannot match their own demands for science and technology. At the same time, colleges and universities are laying more and more importance on the combination of theory and practice, and their social service function is being strengthened. It is urgent to transform scientific research achievements into productive forces<sup>[10]</sup>. However, at present, the licensing and transfer of patents in colleges and universities are strictly limited, which may hinder the commercialization of invention patents. Hence, an effective market-oriented patent transformation mechanism should be established to reduce potential barriers in the process in order to extend the validity time of related technological patents.

#### 5. References

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