

# Zirconia ceramic PCB, for applications in the field of microwave communication

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Before discussing the application of zirconia ceramic substrate, let's first understand its properties

parameter	data
dielectric constant	9.5-10.5
coefficient of expansion due to heat	6.5-7.5 ppm/°C
insulation resistance	$10^{12}$ - $10^{14}$ Ω.cm
heat resistance	It can be used in about 1000°C
mechanical strength	Bending strength 1200 MPa and yield strength 900 MPa
chemical stability	Can work in acidic and alkaline environments, with excellent corrosion resistance
thermal conductivity	Up to the 25 W / m-K above
hardness	Between 9-9.5, more than the traditional ceramic materials
Use the temperature range	-269°C to 850°C
Corrosion resistance	Acid resistance, alkali resistance, corrosion resistance can reach the PH value between 2 and 12

Because of the interesting properties of the zirconia ceramic substrate, it is usually used in communication and aerospace products with higher circuit performance requirements. Here are some of the common applications:

1. Communication: microwave communication equipment, radar system, antenna array, radio frequency module, etc.
2. Aerospace: missiles, satellites, avionics equipment, aviation navigation system, rockets, etc.

It is worth noting that the zirconia ceramic circuit board is also widely used in industrial, medical, military and other fields.



Below, we focus on some applications of the lower zirconia ceramic circuit board in microwave communication

Zirconia ceramic circuit board is a circuit board material, which plays a vital role in microwave communication equipment.

According to statistics, the global mobile communication users have exceeded 6 billion, among which 4G and 5G networks are more and more widely used. These communication equipment needs to have frequency, fast transmission and stability characteristics, and the zirconia ceramic circuit board is the ideal choice to meet these requirements.

Specifically, zirconia ceramic circuit boards have the following advantages:

1. Frequency performance: the dielectric constant of zirconia ceramic circuit board is usually between 9-10, and the dielectric loss is about 0.0005. These data show that zirconia ceramic circuit board has very high performance in frequency signal transmission. For example, in a microstrip line experiment with a frequency of 2.4 GHz, the signal transmission loss of zirconia ceramic circuit board is only 0.37 dB, while the signal transmission loss of FR 4 circuit board is 2.77 dB, indicating that the frequency performance of zirconia ceramic circuit board is significantly better than that of conventional circuit board.

2. Reliability: the strength of zirconia ceramic circuit board, temperature resistance, corrosion resistance and other characteristics, can ensure the reliability of communication equipment in a harsh environment. For example, in an experiment in a warm environment, the transmission loss of zirconia ceramic circuit boards was reduced by about 50% compared with FR 4 circuit boards. At the same time, in the corrosion environment, the zirconia ceramic circuit board also showed a strong corrosion resistance.

3. Precision: The processing accuracy of zirconia ceramic circuit board is very high, which can meet the requirements of small size and density. For example, in a microband antenna experiment, microband antennas made from zirconia ceramic circuit boards have smaller sizes and more performance than microband antennas made from conventional circuit boards.

4. Good thermal stability: the thermal expansion coefficient of zirconia ceramic circuit

board is similar to that of silicon chip, which is not easy to damage the chip due to thermal expansion and cold contraction. For example, in an experiment under a temperature environment, the transmission loss of the zirconia ceramic circuit board is very little, indicating its good thermal stability in the temperature environment.

It is expected that the global zirconia ceramic circuit board market size will reach us \$8 billion in 2025.

In conclusion, the performance of the zirconia ceramic circuit board is indeed very much, and there are a large number of experimental data to verify. Therefore, it is becoming more and more widely used in microwave communication devices.

Microwave communication is a kind of communication mode of frequency, rate and accuracy, so it is necessary to use materials and equipment with excellent frequency performance, reliability, processing accuracy and good thermal stability to ensure the quality and stability of communication.

Specifically, frequency performance refers to the dielectric performance of material at frequency, including dielectric constant, dielectric loss, etc. These indicators are directly related to the transmission loss and bandwidth of microwave signal, so the frequency performance of material is very important for microwave communication.

Reliability means that the material can maintain good performance and stability in extreme environments, including temperature, pressure, radiation, corrosion and other environments. These environments often appear in aerospace, military and other fields, so communication equipment needs to be very reliable.

Processing precision means that the material can meet the requirements of small size, density and other requirements, because microwave communication equipment usually has a very small volume and complex structure, need to use accurate materials and equipment to achieve.

Good thermal stability refers to the material can maintain stable performance in temperature environment, because microwave communication equipment usually needs to work in temperature environment, and the material with good thermal stability is used to ensure the performance and life of the equipment.

Therefore, zirconia ceramic circuit board has excellent frequency performance, reliability, processing accuracy and good thermal stability, which is very suitable for microwave communication equipment, which can ensure the quality and stability of communication, and improve the performance and reliability of communication equipment.

Zirconia ceramic substrate is one of the commonly used materials in the field of microwave communication, because to its excellent properties, its future application prospects are very broad. The following is the future trend of zirconia ceramic substrate in the field of microwave communication:

1. Working frequency: At present, the working frequency of zirconia ceramic substrate is generally between 1 and 18 GHz. With the rapid development of microwave communication field in the future, the demand will be more and more, so the working frequency of zirconia ceramic substrate may be further improved to meet the demand of fast and broadband communication.

2. Development of new zirconia ceramic substrate: In the future, the development focus of zirconia ceramic substrate may be the design of new zirconia ceramic substrate, such as multi-layer structure, composite structure, etc., in order to improve its specific properties and meet the needs of different applications.

3. Miniatur: With the miniaturization of wireless communication equipment, the size of zirconia ceramic substrate may be further reduced in the future, and its weight will be lighter while ensuring performance.

4. Innovative manufacturing process: the future manufacturing process of zirconia ceramic substrates may also be innovative, using new materials and technologies to improve production efficiency and gross margin.

At present, the zirconia ceramic circuit board produced by Slitone ceramic circuit board has tended to mature stage, and its 0.2mm line width / distance process also tends to be established in the market.

