Characteristics and application of hybrid ceramic bearings

Ceramic materials have always been the most interesting material for bearing research Chris Industrial Technology company. The term "ceramic bearing" usually envisions a bearing that is completely made of ceramic and that runs red and hot without lubrication. Much of the early work focused on the study of all-ceramic bearings in high-temperature environments, such as air turbine engine bearings. Such bearings are still continuing, but there is a need to improve the lubrication system. Recent development work has focused on steel ferrules or hybrid bearings consisting of raceways and ceramic balls. Hybrid bearings have been used in applications where machine tool spindles are so urgently needed, and their use is becoming more widespread.

There are many types of ceramic materials with different compositions, microstructures and properties. Silicon nitride materials have proven to have the best physical and mechanical properties for use in bearings. The annual production of silicon nitride balls worldwide is estimated to be several million.

The most important characteristics of hybrid ceramic bearings compared to all-steel bearings of the same type are:

1. The running speed is increased because the low density of the silicon nitride balls means that the centrifugal force is reduced.

2. Increased rigidity because the elastic modulus of silicon nitride is 50% larger than that of bearing steel.

3. The heat is reduced because the silicon nitride ball has the characteristics of small friction coefficient and good sports performance.

4. Thermal stability is better because silicon nitride has a thermal expansion coefficient that is one-third that of steel.

5. Design flexibility is greater because the properties of silicon nitride materials allow bearing designers to change different parameters without having to consider the effects.

Ceramic bearing applications:

When applied to ***Cylindrical Roller Bearing***, these features increase productivity and processing accuracy and improve product quality. Lubrication devices traditionally used for high-speed spindle bearings generally use an oil-air or oil mist lubrication system because grease lubrication reduces the performance of all-steel bearings. On the other hand, hybrid bearings can be safely greased. For machine tool builders, eliminating oil-gas lubrication systems can significantly reduce costs.

Hybrid ceramic bearings for use in aircraft engines are also under development. Air turbine

engines operate at high speeds, and the centrifugal force generated by the balls in their bearings often becomes a major factor limiting the maximum engine speed. Hybrid bearings with low-density silicon nitride balls offer the possibility of operating at higher speeds, combined with less heat inside the bearings, which can significantly reduce weight.

The most common form of hybrid ceramic bearings is an angular contact ball bearing with a silicon nitride ball that can effectively operate at high speeds with both radial and axial loads. However, the axial load can only be applied from one direction. These bearings are therefore usually mounted in pairs and preloaded to ensure the correct contact angle. Angular contact ball bearings and deep groove ball bearings have a larger opening at one end, so a reinforced phenolic resin cage is usually used. Some hybrid bearing products only turn the steel ball into a silicon nitride ball in terms of materials, but on the other hand, the geometry of the channel has also been improved to optimize bearing performance. Other types of ceramic balls can be used in special applications such as instrument bearings and gyro bearings.