What is TEC

TEC is a semiconductor cooler, which is the abbreviation of Thermo Electric Cooler in English. It is made by exploiting the Peltier effect of semiconductor materials. The so-called Peltier effect refers to the phenomenon that when a DC current passes through a galvanic couple composed of two semiconductor materials, one end absorbs heat and the other end releases heat. Therefore, TEC is also called a thermoelectric cooler. Working principle of TEC The smallest unit of TEC is composed of a pair (group) of N-type and P-type semiconductors plus connecting electrodes (sintering points). The connecting electrodes form a cold end and a hot end (see Figure 1). Under the action of an external electric field, the current can bring the heat generated in the semiconductor from one end of the TEC to the other end, creating a "hot" side and a "cold" side on the TEC. When the current direction is reversed, it will cause the hot and cold end faces of the TEC to switch (see Figure 2). This is the principle of TEC heating and cooling.

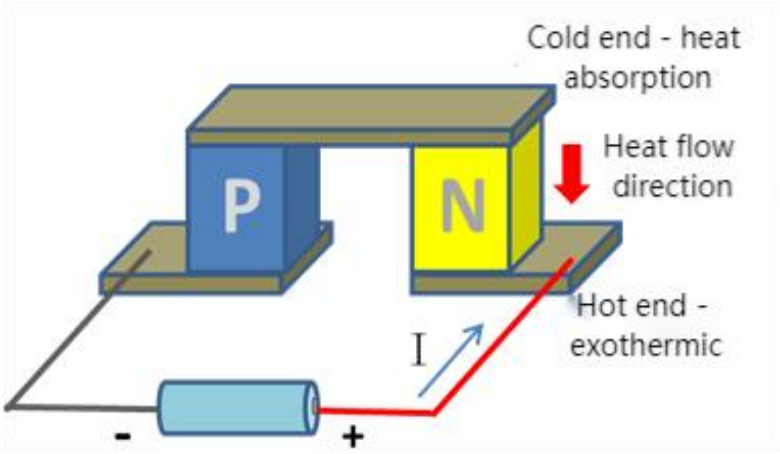

Figure 1

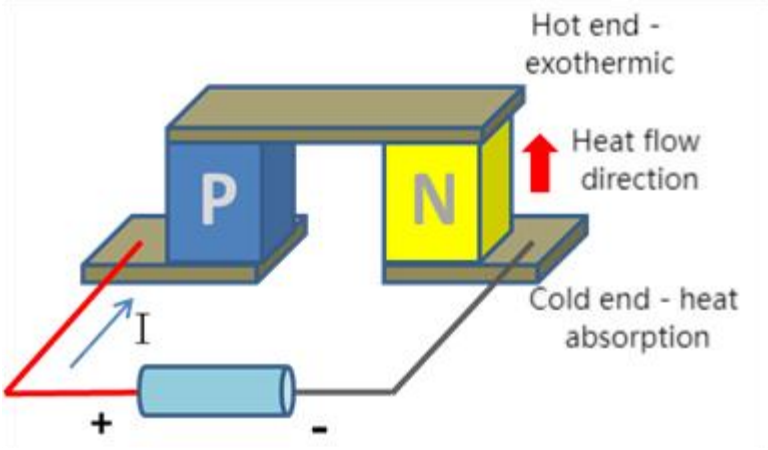

Figure 2

Structural composition of TEC The composition of a TEC thermoelectric cooler includes internal semiconductor P pole, semiconductor N pole and conductive metal, as well as a ceramic substrate for temperature exchange on the top and bottom layers. The cooling capacity of a single thermoelectric

refrigeration pair is limited, and TEC is generally composed of a dozen to dozens of refrigeration pairs (see Figure 3). By controlling the direction of current, TEC can perform both cooling and heating, achieving temperature control stability better than 0.1°C.

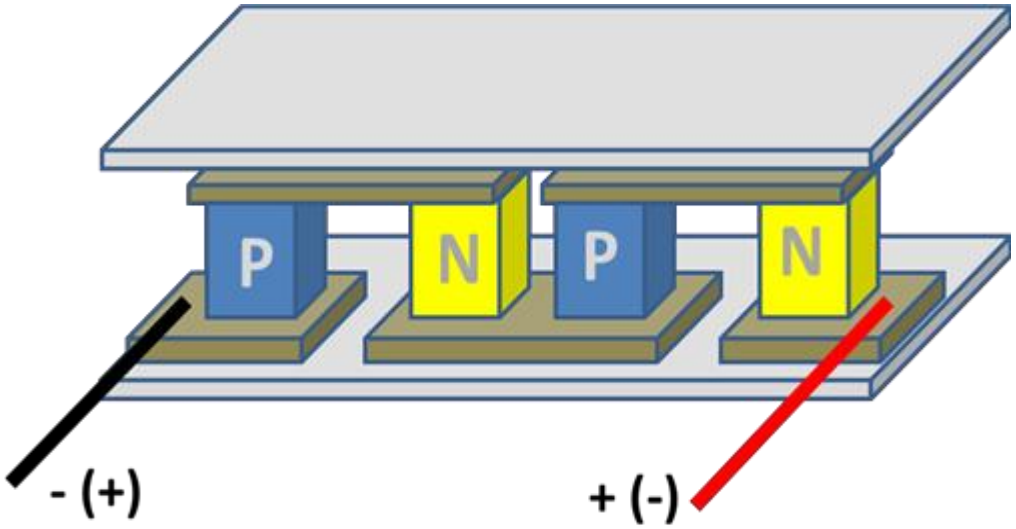

Figure 3

Characteristics of TEC

TEC has the characteristics of no noise, no vibration, no need for refrigerant, small size, light weight, etc. It is reliable in operation, easy to operate, fast in cooling and heating, easy to adjust, and precise in temperature control. However, its cooling coefficient is relatively small and its power consumption is relatively large, so it is mainly used in situations where the cooling consumption is small and the floor space is small, such as the cooling of certain components in electronic equipment and radio communication equipment.

Characteristics of small TECs used inside optical devices

1. Small size: The size of TEC in optical devices is very small, and the dimensions of the three sides of the thermoelectric pair are less than 0.5mm.
2. High cooling efficiency: The ratio of cooling capacity to the total input TEC power is the cooling efficiency. The higher the cooling efficiency, the less TEC power is consumed to remove the same heat, and the optical device power consumption is also smaller.
3. High reliability: Optical devices with TEC are very expensive, and many are used in transmission networks, which require carrier-grade reliability. Most of the TEC used in current optical devices is imported from Japan, the United States and Russia.

Technical parameters of small semiconductor refrigeration chip TEC

1. Current: The current of the small semiconductor refrigeration chip TEC can be adjusted according to different application scenarios, usually between a few milliamps and hundreds of milliamps.
2. Voltage: The voltage of small semiconductor refrigeration chip TEC varies according to different materials and application scenarios, usually ranging from a few volts to dozens of volts.
3. Thermal conductivity: The thermal conductivity of a small semiconductor refrigeration chip TEC is an important parameter to measure its cooling effect, usually ranging from a few watts to tens of watts.
4. Maximum temperature difference: The maximum temperature difference of a small semiconductor refrigeration chip TEC is a measure of its cooling capacity, usually between a few degrees Celsius and dozens of degrees Celsius.
5. Operating temperature range: The operating temperature range of the small semiconductor refrigeration chip TEC is a measure of its ability to adapt to the environment, usually between minus tens of degrees Celsius to plus several hundred degrees Celsius.

Why SOA uses TEC to control temperature

1. Temperature changes will cause the drift of the center wavelength of the SOA chip. The higher the temperature, the central wavelength will shift to the longer wavelength direction.
2. Temperature changes will cause changes in the gain spectrum of the SOA chip. The higher the temperature, the output optical power will decrease.
3. Temperature changes will also cause fluctuations in SOA thermal noise. The higher the temperature, the greater the thermal noise.
4. High temperature will also affect the life of SOA chips. High temperature will accelerate the aging of the SOA chip, and aging will cause the SOA output optical power to decrease.