Comparative Study on Dynamic Earphones and Electrostatic Earphones

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Abstract: With the progress of science and technology, there are many kinds of headphones on the market, and people's requirements for headphones are becoming higher and higher. This article provides a detailed comparison and analysis of dynamic headphones and static headphones, exploring the differences in sound quality, performance, comfort, and other aspects between the two. At the same time, it summarizes the current market situation and future trends. This article aims to provide consumers with valuable reference to help them make more informed decisions when choosing headphones.

Keywords: Dynamic Headphones; Static Headphones; Sound Quality.

1. Introduction

1.1. Research Background

With the continuous development of technology, the requirements for music quality among music enthusiasts are gradually increasing. As one of the main devices for music playback, earphones are receiving increasing attention from users in terms of sound quality, comfort, and durability. Dynamic earphones and electrostatic earphones are two main types of earphones, which have certain differences in phonation principles, sound quality characteristics, and service life. This article will provide a detailed introduction to the origin, development process, and current product status of these two types of headphones, and explain their differences in sound quality, characteristics, and other aspects.

1.2. Research Purpose and Significance

The research significance of dynamic earphones and electrostatic earphones is mainly reflected in two aspects: theoretical research and practical application. In theory, studying the phonation principles and sound quality characteristics of these two types of earphones helps to gain a deeper understanding of the working mechanism of earphones, providing theoretical support for their design, optimization, and improvement. In practical applications, due to the different characteristics of dynamic earphones and electrostatic earphones in terms of sound quality, comfort, and durability, users can choose a more suitable headphone type according to their own needs and preferences. In addition, with the continuous expansion of the consumer market, the competition in the headphone market has become increasingly fierce. Studying the advantages and disadvantages of these two types of headphones helps consumers better understand and choose products that are suitable for them, and also helps manufacturers more accurately position their product direction and target users.

2. Overview of Audio Headphone Technology


Dynamic headphones, as a type of audio device, are widely welcomed for their excellent sound quality and stability. This article will provide a detailed introduction to the working principles and characteristics of dynamic headphones, helping everyone better understand this important audio product.

2.1.1. Working Principle of Dynamic Headphones

The working principle of dynamic headphones is mainly to convert electrical signals into acoustic signals through the action of a magnetic field and coil motion. Specifically, when audio current passes through the coil of a dynamic earphone, the coil generates a magnetic field that interacts with a permanent magnetic field fixed to the earphone casing, causing the coil to vibrate. The coil vibration drives the diaphragm of the earphone unit to vibrate, thereby producing sound.

2.1.2. Characteristic of Dynamic Headphones

Dynamic headphones are known for their beautiful sound quality, low distortion, and high resolution. Its specific advantages are as follows:

1. Mature technology: The structure of dynamic headphones was created by Beyerdynamic DT48 in 1937, with a history of nearly a hundred years and has been upgraded several times, with rich technological accumulation.
2. Diverse price range: From the included earphones on mobile phones to Sennheiser HD800 and Focal Utopia, various grades of dynamic headphones can be provided for consumers with different needs.
3. Easy to drive: Dynamic headphones have high sensitivity and are easy to drive, making the sound more realistic and delicate. Furthermore, the impedance of dynamic earphones is low and can be matched with various types of front-end devices, making users more flexible when choosing front-end devices.

2.2. The Working Principle and Characteristics of Electrostatic Earphones

Electrostatic earphones, as the name suggests, are devices that use static electricity to drive the diaphragm between high-voltage electrodes and produce sound.

2.2.1. Working Principle of Electrostatic Earphones

The structure of an electrostatic earphone is to add an ultra thin diaphragm between two metal plates, and the diaphragm is coated with a layer to make it conductive, then to vibrate...
the diaphragm by using positive and negative electrostatic fields. There are many regular small holes on the metal electrode plate, which let the sound of the diaphragm pass through.

2.2.2. Characteristics of Electrostatic Earphones
   1) Distortion is small, and due to the uniform force distribution of the diaphragm, there is no segmented vibration of dynamic coil vibration.
   2) Low technical barriers make it easy to produce high-quality sound.
   3) It has a realistic sound field performance, and is able to accurately reproduce the placement of instruments during recording, with good separation.

3. Comparative Analysis of Sound Quality between Dynamic Earphones and Electrostatic Earphones

3.1. Sound Quality Differences

3.1.1. Sound Field Performance
   Electrostatic earphones, due to their relatively open structure, can create a wider sound field compared to dynamic earphones. In the process of music appreciation, electrostatic earphones can present a richer sense of spatial hierarchy and a wider sound field, making people feel as if they are on site. Dynamic earphones are relatively weak in terms of sound field performance, but are more suitable for listening to instrument details.

3.1.2. Timbre Restoration
   Electrostatic earphones are more delicate and touching in terms of sound reproduction, presenting rich details and charm of music. It has excellent high-frequency performance and can showcase the delicate emotions of music. The tone of dynamic headphones tends to be strong and powerful, with relatively prominent low-frequency performance, making them suitable for listening to rock and electronics etc.

3.1.3. Detail Expression
   Electrostatic earphones have a high ability to reproduce details and capture subtle dynamics and details in music. This makes static headphones more realistic and more pleasant to listen. The detailed performance of dynamic headphones varies greatly with price, but high-end dynamic headphones still lag behind static headphones in terms of detail performance.

3.2. Comfort
   1) Wearing design: Dynamic earphones are lightweight and not tiring to wear for a long time, while electrostatic earphones are generally heavier and have a noticeable pressure on the head when worn.
   2) Earmuff material: Dynamic earphones are usually made of soft velvet to increase breathability and obtain natural sound. The earmuffs of electrostatic earphones are mostly made of leather, which has good durability.
   3) Head beam design: The head beam design of dynamic earphones mainly considers wearing comfort and stability, while the head beam of electrostatic earphones pays more attention to the impact of its clamping force on sound quality.

3.3. Durability
   Due to the fragility of the diaphragm and coating of electrostatic earphones, their service life is relatively shorter than that of dynamic earphones.

3.4. Voice Personalization
   Whether it’s dynamic headphones or static headphones, they all have their own unique sound styles. Consumers can choose the appropriate earphone type based on their music preferences, but there are the types of electrostatic earphones are more limited.

3.5. Connection Method
   There is a difference in the connection method between static headphones and dynamic headphones. Most electrostatic earphones use STAX 5 pin plugs and need to be used together with specially designed power amplifiers. Traditional dynamic headphones, on the other hand, often use XLR ports, 6.35mm ports, and 3.5mm ports, making them easier to use.

4. Technological Development Trends

4.1. The Development Trend of Dynamic Earphones
   As the mainstream product in the audio device market, dynamic headphones have shown significant development trends in recent years. With the continuous development of technology, dynamic earphone technology is also continuously upgrading. The new dynamic earphone technology is mainly reflected in the following aspects:
   1) Sound quality improvement: By improving the diaphragm material, adjusting the cavity structure, and optimizing the driver unit design, the sound quality of dynamic headphones has been significantly improved. For example, using polymer materials and special alloy cavities can effectively improve the response ability at low and high frequencies, while maintaining clear sound quality.
   2) Comfort optimization: The wearing comfort of dynamic headphones has also been continuously improved. Some high-end products adopt ergonomic designs, such as memory sponge earplugs and adjustable headphone cables, to increase wear stability and comfort.
   3) Wireless trend: In recent years, wireless has become a major development trend in the dynamic headphone market. With the continuous progress of Bluetooth technology and the reduction of power consumption in wireless communication chips, the wireless implementation of dynamic headphones has been achieved.

4.2. The Development Trend of Electrostatic Earphones
   With the development of technology and the increasing improvement of people’s living standards, electrostatic earphones are gradually becoming a star product in the audio market. Electrostatic earphones will continue to be upgraded in terms of high fidelity sound effect and cost-effectiveness.
   1) High fidelity sound effect: For music enthusiasts, high fidelity sound effect is their relentless pursuit of sound quality. Electrostatic headphones provide excellent high fidelity sound effects through their unique working principles and exquisite craftsmanship. Representative products such as the STAX X9000 are highly sought after by netizens due to their open design, wide sound range, and excellent detail capture ability. However, the pursuit of high fidelity sound effects has also raised concerns among some users about price and sound source quality.
2) Miniaturization: Currently, the main usage scenario of electrostatic technology is headphone, but with the application of Sonion EST65 series electrostatic units, more and more combination unit earphones are starting to use electrostatic technology to analyze the high-frequency part of music.

5. Summary and Suggestions

Overall, dynamic headphones and static headphones each have their own advantages and disadvantages, and are suitable for different users and scenarios. For ordinary users, choosing dynamic headphones may be more practical and wise because they perform relatively well in terms of sound quality, comfort, and durability, while also being relatively affordable. However, for some music enthusiasts who pursue the ultimate sound quality experience, static headphones may be more suitable for them. Manufacturers should continuously optimize and improve their products based on market demand to meet users' pursuit of high-quality music experience.

References


