

# Application of Surface Enhanced Raman Scattering Technology in the Detection of Harmful Substances in Food

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**Abstract:** In order to further ensure food safety and solve various food safety problems endangering human life and health, relevant technical operators can apply the new surface enhanced Raman scattering technology to carefully detect various harmful substances in food, so as to avoid a large number of pathogens, related microorganisms, bacteria, viruses and various additives in food. The rational application of surface enhanced Raman scattering technology can provide technical support and guarantee for solving food safety problems. Therefore, the application effect of surface enhanced Raman scattering technology will be analyzed in detail in the following contents.

## 1. Introduction

At this stage, most technical operators have put forward new solutions to problems in combination with food harmful substances and various detection technologies. Some technical operators have realized the advantages of surface enhanced Raman scattering technology. Several common food detection technologies and related safety detection technologies can not fully meet the current food safety detection work. Relevant technical operators need to explore more modern and comprehensive food detection technology and reasonably apply surface enhanced Raman scattering technology. The surface enhanced Raman scattering technology can be used to analyze the relevant pathogens and various flora in food, and can also provide important detection reports and relevant detection basis for relevant inspection departments.

## 2. Discovery of Raman Scattering and Surface Enhanced Raman Scattering

In 1928, the famous Indian physicist Raman explored the inelastic scattering effect of light after a large number of experiments and investigations. This important research achievement is an important prerequisite for the application of surface enhanced Raman scattering technology. The essence of Raman scattering is the inelastic collision between photons and various particle or element excitations in the scattering material. Surface enhanced Raman scattering technology is also applied to this scattering form.

Raman scattering can be used to study the molecular structure of substances and quantitative analysis. However, some scattered light is weak, which means that Raman scattering has some technical limitations. In 1974, Fleischman et al. Found a single-layer pyridine molecule on the surface of rough silver electrode and a more powerful scattering signal by studying the relevant scattering signals in the electrochemical cell. Subsequently, in 1977, a total of 13 scientists verified the previous experimental results and obtained a more comprehensive definition of Raman scattering. Therefore, the so-called surface enhanced Raman scattering (SERS) effect appeared. In short, in the process of applying surface enhanced Raman scattering technology, when material molecules are adsorbed on some specific metal surfaces, the relevant Raman signals can show a very obvious enhancement trend. The birth of surface enhanced Raman scattering technology means the all-round optimization of Raman scattering theory.

### **3. Analysis of Specific Methods for Detecting Harmful Substances in Food by Surface Enhanced Raman Scattering**

#### **3.1 Detection of Staphylococcus Aureus in Food by Surface Enhanced Raman Scattering**

Staphylococcus aureus and related accessory bacteria widely exist in food and drugs. Such bacteria can produce huge enterotoxins. If people eat such bacteria by mistake, it is very easy to cause acute gastroenteritis, followed by vomiting and food poisoning. In the face of this situation, the author will prepare gold nano substrate by sol method in the following contents of the article, and then carefully analyze the change law of flora and the change trend of flora with the help of Raman scattering theorem, surface enhanced Raman scattering technology and related specific technologies.

This experiment mainly uses surface enhanced Raman spectroscopy and related Raman scattering principles. The main purpose is to detect the reproduction law of Staphylococcus aureus in specific foods. At present, Staphylococcus aureus has shown a more complex evolution law and reproduction process in the process of daily practice. Therefore, Raman spectroscopy needs to be continuously enhanced in order to quickly identify various pathogenic bacteria and ensure the safety of people's lives and property. The application of this method is mainly to reduce the cost of food testing, and then use more modern food testing technology. Enhance the reliability of food testing. Reasonable application of Raman scattering principle and surface enhanced Raman scattering technology can effectively detect residual Staphylococcus aureus in food, which has very typical practical significance. The application of surface enhanced Raman spectroscopy to detect all kinds of Staphylococcus aureus in food provides a more reliable experimental basis for the diagnosis of Staphylococcus aureus infection source. Such technology can also be used for clinical infection diagnosis and quality inspection in food and drug hygiene supervision and commodity industry.

#### **3.2 Detection of Illegal Food Additives by Surface Enhanced Raman Scattering**

With the rapid development of modern food industry, a large number of illegal additives are added to many foods. Some chemical additives are likely to threaten the safety of people's lives and property, and may also cause serious harm to the health of some specific people. If a large number of illegal additives are added to food and drugs, it will seriously affect the actual efficiency of food and drug safety inspection. Therefore, in the process of using Raman spectroscopy to detect illegal additives in food, the specific application methods of surface enhanced Raman scattering technology must be considered. The application of surface enhanced Raman scattering technology in the detection of illegal food additives is rare, but its technical advantages have been recognized by many experts in the industry. Surface enhanced Raman spectroscopy needs to combine laser technology and nanotechnology, preliminarily integrate a series of modern food quality detection technologies, and integrate surface enhanced Raman scattering technology to detect various illegal additives and chemical reagents in food. In general, Raman spectroscopy can be used to detect all kinds of chemical additives contained in food, such as acid orange II, malachite green, Sudan red, melamine, polycyclic aromatic hydrocarbons in water, fentanyl and so on. The author will make a detailed analysis combined with specific chemical additives in the following contents of the article.

##### **3.2.1 Detection of Illegal Colorants Such as Acid Orange II, Malachite Green and Sudan Red by Surface Enhanced Raman Scattering**

Acid orange II, Sudan red, malachite green and related illegal colorants are prohibited products by relevant departments of the national government. Such illegal colorants will have a very serious negative impact on human health. The detection of such illegal colorants can be applied to Raman spectroscopy and related surface enhanced Raman scattering techniques. Firstly, relevant technical inspectors need to observe the main internal structure and relevant molecular structure of illegal colorants in combination with electron microscopy and various modern microscopic equipment. Zou Shiyong and Li Tao prepared silver mirror substrate with enhancement factor of  $3.8 \times 10^4$  by silver mirror reaction, and detected Sudan I samples by Raman spectroscopy. Then combined with silver nanoparticles and surface enhanced Raman spectroscopy, the other three azo dyes (methyl

yellow, methyl red and Sudan I) were analyzed and chemically detected. Lopez, Carolina and others have studied Sudan I by surface enhanced Raman spectroscopy. Through this method, Sudan I can be accurately distinguished from other analogues. Lee et al. Used silver sol surface enhanced Raman spectroscopy to detect malachite green dye in water, and obtained more scientific detection results. Zhang et al. Used Raman spectroscopy and surface enhanced Raman scattering technology to test malachite green in some Tilapia on the market. It is found that the detection limit can reach 200ng / g and the correlation detection coefficient is 0.843.

### **3.2.2 Detection of Melamine, Fentanyl and Polycyclic Aromatic Hydrocarbons by Surface Enhanced Raman Scattering**

Melamine, fentanyl, polycyclic aromatic hydrocarbons and other substances are more complex chemical additives, especially trimeric hydrogen ammonia, which can seriously affect the normal development of infants and young children. After a series of experimental operations, mecker, Tang Junqi, Zhao and others applied surface enhanced Raman spectroscopy to study the correct method for detecting illegal additives of ammonia trichloride. Fentanyl is a powerful anesthetic and analgesic. Kong lingce et al. Used silver colloid as the substrate and combined with surface enhanced Raman scattering technology to analyze a small amount of fentanyl in the aqueous phase. The experimental results clearly show that with the continuous increase of the concentration of silver colloid, the fentanyl component gradually appears. When the concentration of sodium chloride solution is 0.01m, the fentanyl component shows a very strong Raman spectrum signal, The detection limit of related components can reach 0.1mg/kg. Polycyclic aromatic hydrocarbons (PAHs) are persistent pollutants with strong toxicity and carcinogenicity, and their carcinogenic effect is obvious. Casta et al. Combined with the specific application method of surface enhanced Raman scattering technology, carried out chemical analysis on polycyclic aromatic hydrocarbons and found that the detection results of polycyclic aromatic hydrocarbons in the environment are as high as a few parts per million.

## **4. Application Prospect of Surface Enhanced Raman Scattering Technology in the Detection of Harmful Substances in Food**

At present, the application of surface enhanced Raman scattering technology has shown a more diversified development trend, and some advanced food detection technologies have been quietly born. The internal structure of some illegally added substances and chemical reagents is complex. The application of Raman spectroscopy for technical detection can help relevant technical operators find all kinds of microorganisms, flora and related illegally added substances in food more intuitively and clearly. At the same time, surface enhanced Raman scattering technology belongs to a nondestructive testing technology. Compared with other food detection technologies, it has obvious technical advantages, does not need to spend a lot of technical detection costs, and is not easily affected by water molecules in food. It can detect relevant substances in food more conveniently and quickly. At present, surface enhanced Raman scattering technology has been widely used in food composition analysis, raw material quality detection and pesticide residue detection. In the future, surface enhanced Raman scattering technology will also be applied to the detection of excessive microorganisms, adulterated food and toxic substances.

Even if surface enhanced Raman scattering technology has strong advantages and technical advantages, it does not mean that surface enhanced Raman scattering technology has been developed completely. Surface enhanced Raman scattering technology has high requirements for relevant technical operators and a series of equipment. If the relevant technical operators cannot accurately understand the specific application process and relevant application principles of surface enhanced Raman scattering technology, it is very easy to lead to various technical operation problems and equipment failures in the process of applying surface enhanced Raman scattering technology. This means that Raman spectroscopy and related surface enhanced Raman scattering technology still have bright development prospects. In the near future, both the application effect of surface enhanced Raman scattering technology and various technical test results will show

diversified development characteristics.

## 5. Conclusion

In order to further improve the quality of food safety inspection, it is necessary to explore the correct application methods of Raman spectroscopy and the related theorems and principles of Raman scattering. Relevant technical operators need to combine Raman spectroscopy and a series of surface enhanced Raman scattering technologies to carefully analyze specific problems in food testing, and carry out comprehensive inspection and technical inspection in combination with a specific additive or a specific flora in food. After a lot of research and investigation, the author has explored the specific application methods of surface enhanced Raman scattering technology. It is hoped that through this research, the actual efficiency of food detection can be further improved.

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