Surface-enhanced Raman spectroscopy for human blood analysis

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***Abstract*—the implementation of surface enhanced Raman spectroscopy (SERS) for the detection of disease has increased in recent years. The reasons for their increased implementation have often been attributed to their well-known advantages, including the production of narrow spectral bands, which are characteristic of the molecular components present, their non-destructive method of analysis and the sensitivity and specificity which they can confer. In this study, human blood samples were examined using SERS. The obtained results demonstrate that the proposed SERS technique is stable and has significant potential in clinical diagnosis applications.**

Keywords— surface-enhanced Raman spectroscopy, Enhancement Factor, blood, silver nanoparticles, Raman band shift

INTRODUCTION

In latest years, Surface-enhanced Raman Scattering (SERS) spectroscopy has been increasingly used with the aim of developing diagnostic applications. The high sensitivity, the ease of use and the increasing availability of relatively inexpensive portable Raman instruments, make SERS particularly attractive for the development of point-of-care and screening tests of biological samples, such as blood derivatives or tissues. In the current work to implement a simple analysis of human blood using SERS, a silver SERS substrate was prepared. The goal of this work was to develop a SERS technique based on sliver nanoparticles (Ag NPs) application for simple, reliable and rapid analysis of human plasma. To assess the prospects of the proposed SERS technique.

MATERIALS AND METHODS

Silver nanoparticles were utilized as the SERS substrate. Silver nitrate and trisodium citrate were used as starting materials for the preparation of silver nanoparticles. The silver colloid was prepared by using chemical reduction method.

The experimental setup for blood includes a spectrometric system (EnSpectr R785, Spektr-M, Chernogolovka, Russia) and a microscope (ADF U300, ADF, China). Focusing the exciting radiation and collecting the scattered radiation were implemented using 50x Objective LMPlan. The stimulation of collected spectra was performed by the laser module with central wavelength 785 nm.

To study the human blood sample, the blood samples were defrosted at room temperature. Each blood samples were dropped in a volume of 1.5 µl and dried for 30 minutes on aluminum foil with the layer of dried silver colloid for SERS analysis.

RESULTS AND DISCUSSION

The observed SERS bands were analyzed. Several of these bands clearly stand out by the impact of SERS technique . The SERS spectrum of blood showed many dominant vibration bands, indicating a strong interaction between the silver colloids and the blood substances. This interaction also indicated that biochemical ingredients in the blood were closely adsorbed onto the surfaces of the silver nanoparticles, and Raman scattering took place in the highly localized optical fields of these structures, which resulted in a strong enhancement in the intensity.

CONCLUSION

In this study human blood samples were examined using newly proposed SERS technique. The obtained results indicate accuracy and stability of the proposed SERS substrates., the proposed SERS technique provides a capability to detect Raman bands which may be attributed to such biochemical components as nucleic acids, carbohydrates, lipids, etc. SERS analysis increases the possibility to detect disease biomarkers during blood samples analysis. The obtained results demonstrate that the proposed SERS technique is stable, no-invasiveness with no blinking phenomenon and has significant potential in clinical diagnosis applications

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