

SURFACE ENHANCED RAMAN SPECTROSCOPIC CHARACTERIZATION OF BLOOD AND PLASMA FOR HIV-1 INFECTION

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Abstract

In an attempt to come up with early detection mechanisms of the HIV-1 virus, several investigations have been carried out. The current detection mechanisms are either expensive, require skilled personnel or are not sensitive enough to detect the virus at its early stages. These challenges triggered this study. The applications of extending the usage of silver nanoparticle based surface-enhanced Raman Spectroscopy (SERS) to obtain blood and its corresponding plasma biochemical information for a rapid non-invasive HIV-1 detection were researched in this paper. SERS measurements were performed on four groups of samples: the first and second group from blood and plasma obtained from patients (n=48) with pathologically confirmed HIV-1 infection and the other two groups comprising blood and plasma from healthy volunteers (control subjects, n=28). Raman spectral profiles of blood and plasma samples were measured using confocal Raman microscope with 785 nm wavelength laser excitations. From the spectral profiles of the bio constituents, noticeable difference was observed between the infected and control samples. The spectrum of the HIV-1 positive blood and negative blood contains numerous Raman peaks. The most prominent peaks are 477 cm⁻¹, 725 cm⁻¹, 933 cm⁻¹, 1094 cm⁻¹, 1206 cm⁻¹, 1275 cm⁻¹ and broad peaks at 1322 cm⁻¹ and 1445 cm⁻¹ which are characteristic of the Raman spectra of biological cells. The spectra of both blood and plasma from HIV-1 patients showed a noticeable overall decrease in peak intensity. Tentative assignments of the Raman peaks in the measured SERS region suggested HIV-1 specific biomolecular changes including; a general drop in total proteins, nucleic acid and lipids contents. However, the intensities of 1206 cm⁻¹ and 1445 cm⁻¹ peaks corresponding to ring vibrational mode of Tyrosine and Phenylalanine and bending vibrational mode in proteins and lipids respectively were relatively more prominent in infected blood spectra. Our test results showed that SERS blood and plasma test could be a potential HIV-1 screening and early detection technique.

Key words: Raman Spectroscopy, characterization, HIV-1, rapid detection, blood plasma, SERS