

Surface-enhancement of DNA molecules in cancer and stem cells by silver nanoparticles with reduced graphene oxide

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Introduction

With the advancement of technology the number of applications for many different spectroscopy methods has increased. For example in Raman spectroscopy this is done by using multiple lasers or by modifying the substrate to enhance the signal of the specific molecules [1]. In the medical applications the latter option is preferred, due to possibility of damaging the sample by using too much laser power. Therefore surface-enhancement with plasmonic materials, such as gold or silver, is used (Fig.1). Furthermore with the introduction to create single graphene layers it has been also incorporate to Raman spectroscopy as a good signal enhancer [2].

As such, combination of Silver nanoparticles (AgNPs) in composition with reduced graphene oxide (rGO) is proposed for detection and enhancement of DNA molecules (adenine (A), cytosine (C), guanine (G), thymine (T) and uracil (U)) in stem and cancer cells.

Method

With the use of noble metal AgNPs we have electromagnetic enhancement due to plasmonic effect. By adding graphene there is additional chemical enhancement and decrease of background fluorescence.

The used cancer and stem cells were left in room temperature (24°C) for 3 different time frames: 1 day, 3 or 4 days and 7 days (Fig.2, Fig.3). This is so that we could induce apoptosis to have 3 different types of cells: alive, half-dead and dead [3]. Dying of cells would be caused because of either by loss of food in medium or not being able to adapt to the temperature.

For our substrate we chose quartz due to it being less fluorescent and modified it with amino saline for better cell attachment.

In current Raman measurements 532nm laser excitation was used.

Results

Highest enhanced DNA constituent with our surface-enhancer material was adenine molecule. Having 14x enhancement with cancer cell and 15x with stem cell.

References

- [1] Materials Today, 15(1-2), pp.16–25, 2012.
- [2] Nano Letters, 15 (5), pp. 2892–2901, 2015.
- [3] Scientific Reports 4, Article number: 4698, 2014.

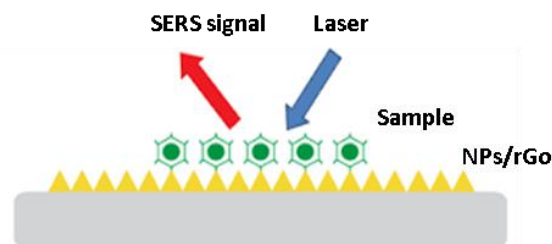


Fig.1 Surface-enhanced Raman spectroscopy signal by using noble metal NPs or rGO on the substrate.

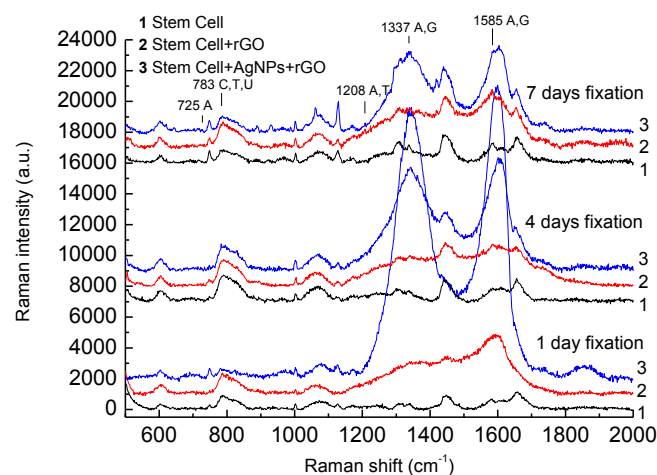


Fig.2 Raman spectra of stem cells on amino saline treated quartz substrate (1); rGO droplet (2); or rGO+AgNPs droplet (3) with 1, 4 and 7 days before fixation. Mentioned numbers correspond to DNA molecule vibrations.

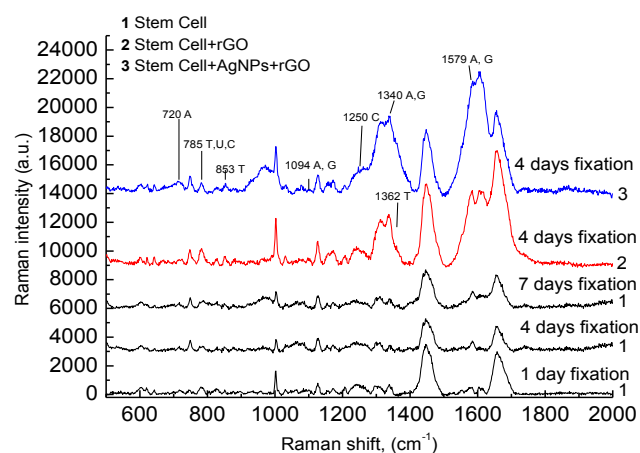


Fig.3 Raman spectra of cancer cells on amino saline treated quartz substrate (1); rGO droplet (2); or rGO+AgNPs droplet (3) with 1, 4 and 7 days before fixation. Mentioned numbers correspond to DNA molecule vibrations.