

Raman Tweezers Study of Size Dependent Effect of Silver Nanoparticles on RBCs

DAMP, Manipal Univ.¹, Surekha Barkur¹, Aseefhali Bankapur¹, Santhosh Chidangil¹

E-mail: surekhabkr@gmail.com

Raman Tweezers technique has become popular in single cell studies. This technique combines Raman spectroscopy with optical tweezers enabling study of biochemical changes of single and live cells. The applications of Raman Tweezers include studying blood cells, monitoring blood related disorders, silver nanoparticle induced oxidative stress etc. [1,2]. There is an increased interest in the toxic effect of nanoparticles with large scale applications of nanoparticles in consumer products such as drugs, cosmetics etc. The interaction of these nanoparticles with the cells may vary with their size as the physical and chemical properties of these nanoparticles vary with size [3]. We have studied the effect of silver nanoparticles of sizes 10nm, 40nm and 100nm on red blood cells (RBCs) using Raman Tweezers technique. Our aim was to investigate the size dependent stress of nanoparticle on RBCs.

25 μ l of RBCs (diluted in 2 ml of phosphate buffer saline) were treated with 50 μ l (0.015mg) of nanoparticles and incubated in CO₂ incubator. Raman spectroscopic measurements were done after 24 hours and 48 hours of incubation. All the spectra were recorded with 10mW laser power (785nm diode laser), 60s of accumulation time and 2 accumulations. The average spectra of control and nanoparticle treated RBC spectra after 48 hours of incubation is shown in figure 1. Major changes were observed in the peaks 565 cm⁻¹, 1211

cm⁻¹, 1224 cm⁻¹, 1375 cm⁻¹, 1635 cm⁻¹. A decrease in intensity of 565 cm⁻¹, increase in 1211 cm⁻¹ with a reduction in 1224 cm⁻¹, increase in intensity of 1375 cm⁻¹, also peak disappearing at 1635 cm⁻¹ indicates deoxygenation of hemoglobin. Nanoparticles with 100nm size were showing maximum spectral changes.

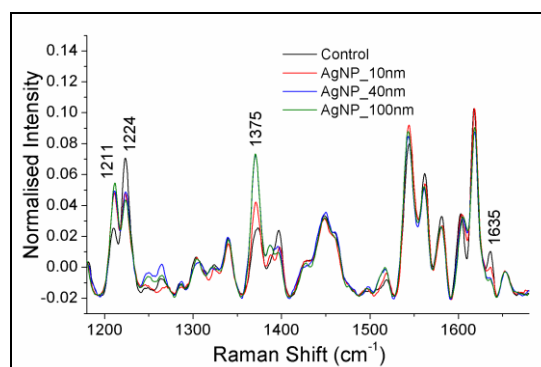


Figure 1: Average of 25 Raman spectra of Control RBCs, RBCs treated with silver nanoparticles of size 10nm, 40nm and 100nm

References

- [1] A. Bankapur, E. Zachariah, S. Chidangil, M. Valiathan, and D. Mathur, Raman tweezers spectroscopy of live, single red and white blood cells, *PLoS one* 5, e10427_1 (2010).
- [2] A. Bankapur, S. Barkur, S. Chidangil, and D. Mathur, A Micro-Raman Study of Live, Single Red Blood Cells (RBCs) Treated with AgNO₃ Nanoparticles, (2014).
- [3] L. Shang, K. Nienhaus, and G. U. Nienhaus, Engineered nanoparticles interacting with cells: size matters, *J Nanobiotechnol* 12, b67 (2014).