# HIGH SENSITIVITY DETECTION OF NBT ON NOVEL SERS SUBSTRATE

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**Introduction.** Surface-enhanced Raman scattering (SERS) is rapidly evolving as a useful analytical tool in chemical and biological analysis. The most critical aspect of SERS is the research of efficient SERS-active substrates, such as nanostructured surface or nanoparticles of noble metals with suitable physical parameters such as their material, size, shape, and spacing [1]. Generally, Ag and Au substrates are regarded as one of the best candidates for SERS. Nevertheless, fabrication of SERS substrates with both high sensitivity and high reproducibility remains difficult, and it is costly for routine SERS detection. We report the novel combined substrate for highly sensitive Surface Enhanced Raman spectroscopy (SERS) are capable of detecting 4-nitrobenzenethiol (NBT), as a model Raman active molecule, at very low concentration.

**Materials and methods. We** prepared of Al substrate attaching Al foil on approximately 1x1 cm glass slides, using parafilm to limit spreading of liquid droplets. We prepared NBT solutions in acetonitrile with different concentrations from 1 mM to 10 pM. We dropcasted 25 |ff of prepared AuNP on the Al substrates. After they had dried, we applied 25 |ff of prepared analyzed solutions. Raman spectra were recorded with Raman Microscope LABRAM Horiba with 785 nm excitation with 1 s exposure time for each SERS measurement.

**Results and discussion.** From the data obtained by the calculation Raman spectra (Fig. 1) limit of detection and enhancement factor were determined. We calculated the LOD as a concentration of analyte when the signal is equal to the signal of the blank plus three standard deviations of the blank signal. Twice we obtained LOD for NBT bellow 10 pM ($<10^{-11}$ M). Also after measurement of Raman signal from solid NT at the same imaging parameters we calculated SERS enhancement factor (EF) by the equation

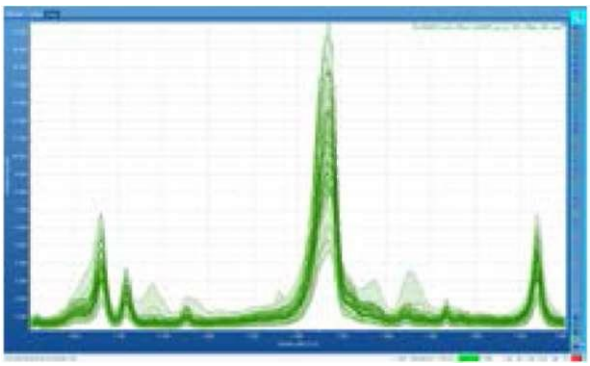

*Figure 1.* Raman spectra of NBT on AuNPs/Al substrate

$$G = \frac{I_{SERS}}{N_{SERS}} \Big/ \frac{I_{Raman}}{N_{Raman}}$$ [2] where N stands for number of molecules in the probed volume and I stands for background corrected peak intensity of the strongest NBT vibration around 1336 $cm^{-1}$.

**Conclusions.** Novel, low cost, sandwich SERS substrate demonstrated ability for very sensitive detection of Raman active molecules. The limit of detection of NBT in sub 10 pM range is already achieved with AuNPs on Al foil. The calculated SERS enhancement factor (EF) near the limit of detection is above $10^8$. Further work will include the comparison of the Al to gold, silver and silicon as supporting films in the sandwich SERS substrates, optimization of the size of gold nanoparticles, sensing on Al film with freshly dissolved oxide layer.

**References.**

1. P. L. Stiles, J. A. Dieringer, N. C. Shah, R. P. Van Duyne. Surface-Enhanced Raman Spectroscopy, *Annu. Rev. Anal. Chem. 2008. 1:601-26,doi:* 10.1146/annurev.anchem.1.031207.112814
2. E. C. Le Ru, E. Blackie, M. Meyer, P. G. Etchegoin. Surface Enhanced Raman Scattering Enhancement Factors: A Comprehensive Study, *J. Phys. Chem. C 2007, 111, 13794-13803*