Observation of DNA Strand interaction with SERS

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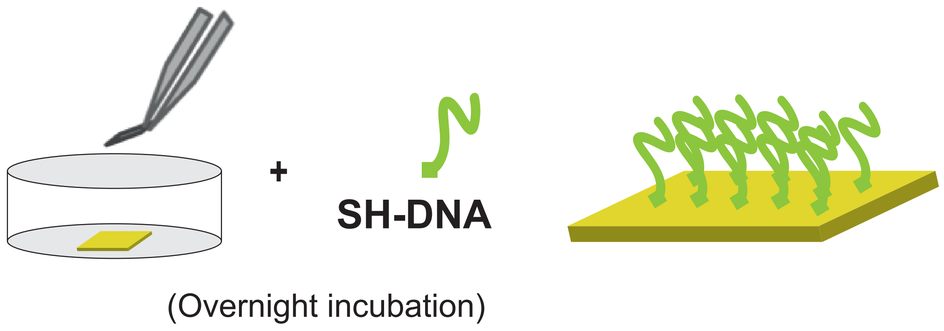
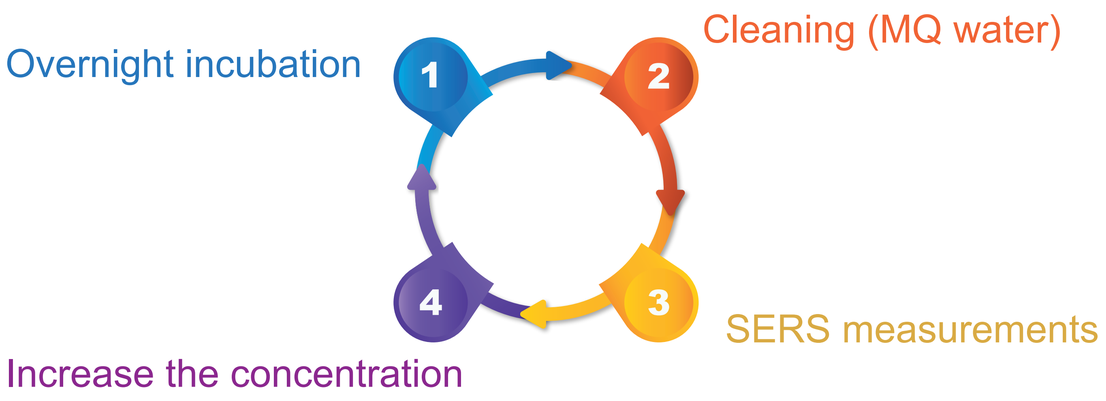
Objectives:

- Develop a SERS biosensor for the detection of biomolecules and biomarkers
- Study the interaction between a DNA sequence consisting of 20 Bases of poly-Thymine (PolyT) with its complementary poly-Adenine (PolyA)

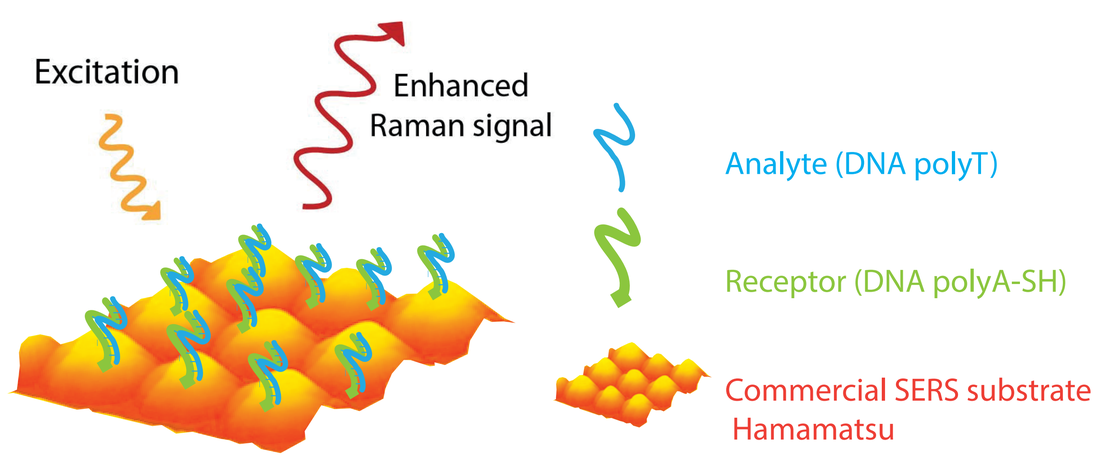
Hybridization with polyA-20SH 10^{-4}M



Hybridization with polyT-20 10^{-7}M, 10^{-6}M, 10^{-5}M, 10^{-4}M

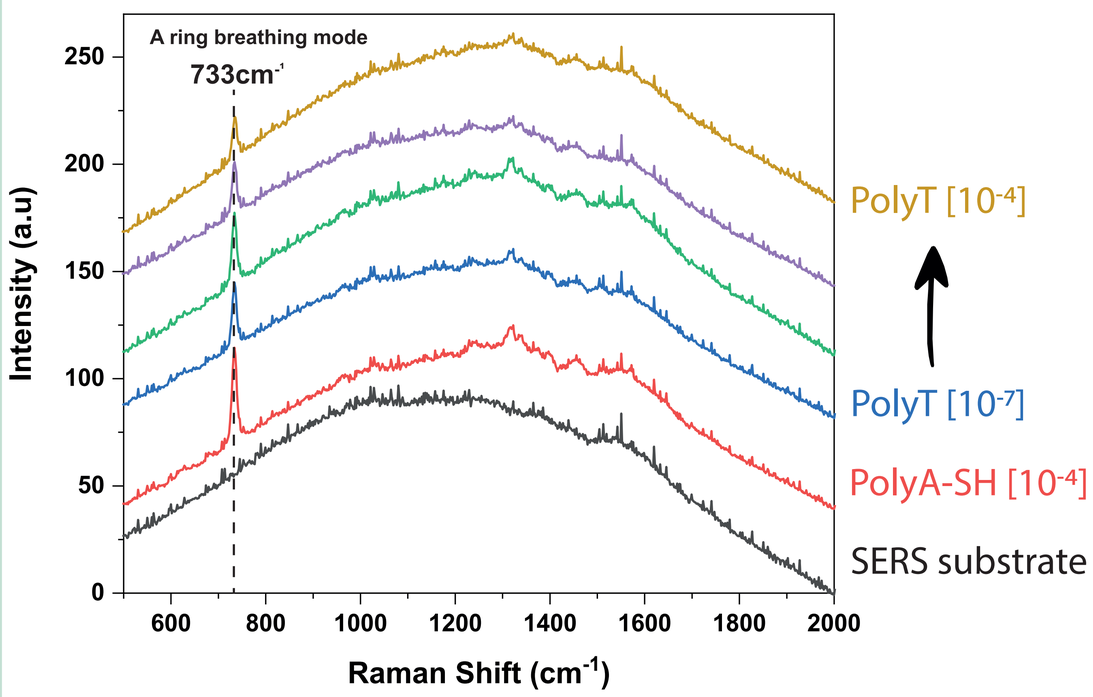


SERS experiments



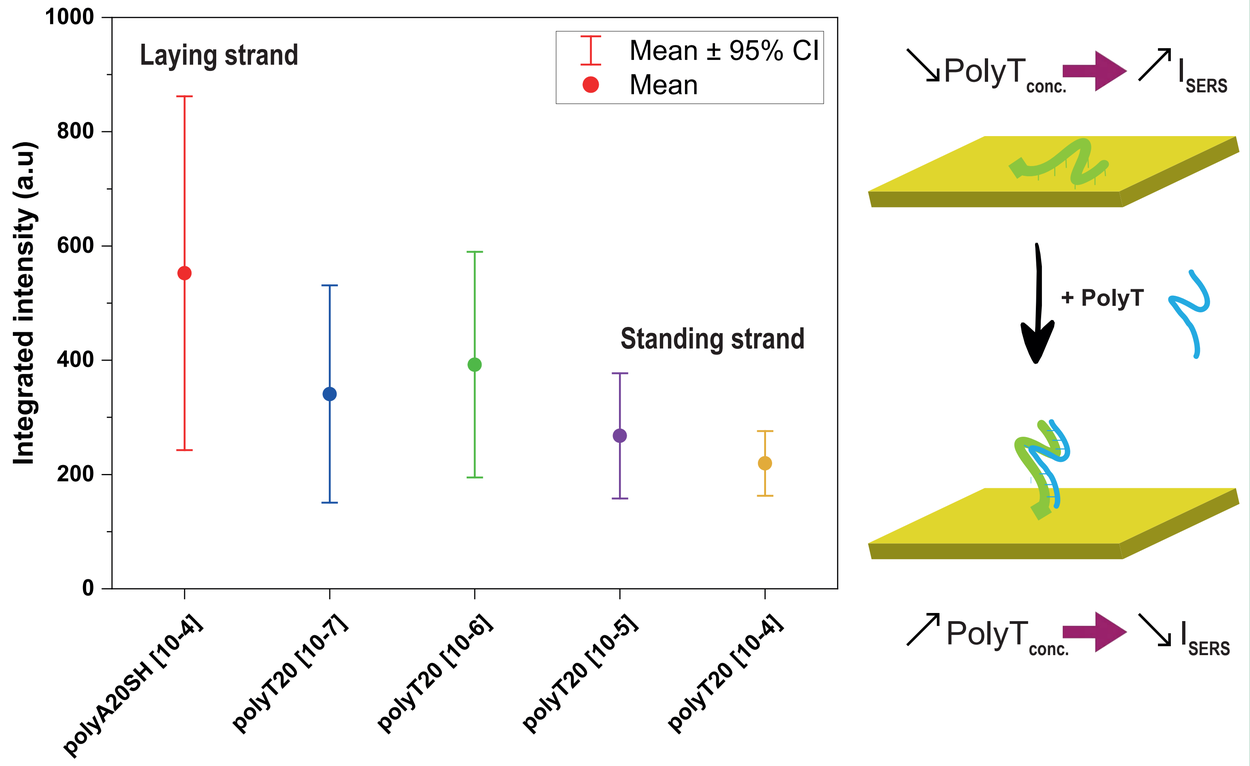
- SERS spectra recorded with a x100 magnification objective (NA= 0.9)
- Excitation Wavelength: 633nm
- 2D Mapping of the surface (20µmx20µm)
- Laser spot 1µm (Step size of 2µm)
- Statistical measurements: 100 spectra X 4 mapping X 2 substrates
  = 800 SERS spectra/concentration

SERS spectra of polyA/polyT interaction



- Each spectrum = average of 800 spectra
- Observation of a single intense band at 733 cm^{-1} assignable to PolyA
- Not able to observe the polyT features

Evolution of the SERS intensity of the band at 733cm^{-1}



- ↗polyT concentration => ↘ intensity and standard deviation
- Large standard deviation => High spectral fluctuations
- High spectral fluctuations => More flexible DNA [2]
- I_{SERS} max: DNA strand close to the surface = Laying strand
- I_{SERS} min: Nucleosides perpendicular to the surface = Standing strand

Conclusions:

- By increasing the polyT concentration, we notice a decrease of the integrated intensity of the polyA band and a decrease of the standard deviation
- The increase of the concentration of PolyT induced a loss of flexibility and a modification of orientation of the PolyT/PolyA molecular complex

References:

[1] A. Azziz, W. Safar, Y. Xiang, M. Edely, M. Lamy de la Chapelle, Sensing performances of commercial SERS substrates. J. Mol. Struct. 2022, 12, 1248.
[2] Safar, W.; Tatar, A. S.; Leray, A.; Potara, M.; Liu, Q. Q.; Edely, M.; Djaker, N.; Spadavecchia, J.; Fu, W. L.; Derouich, S. G. et al. New insight into the aptamer conformation and aptamer/protein interaction by surface-enhanced Raman scattering and multivariate statistical analysis. Nanoscale 2021, 13, 12443–12453.

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