Correlation between DNA bases and the intensity of the Raman bands with SERS

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Objectives

Develop a SERS biosensor for the detection of biomolecules and biomarkers

Bioreceptor: single stranded DNA (ssDNA)

SERS promoter: gold nanoparticle AuNPs

Study the correlation between the DNA sequences and its base composition and the intensity of Raman bands observed in SERS

Functionalization of gold NPS with single strand DNA

Five sequences (S1, S2, S3, S4, S5) with thiol group (SH) at 5' end

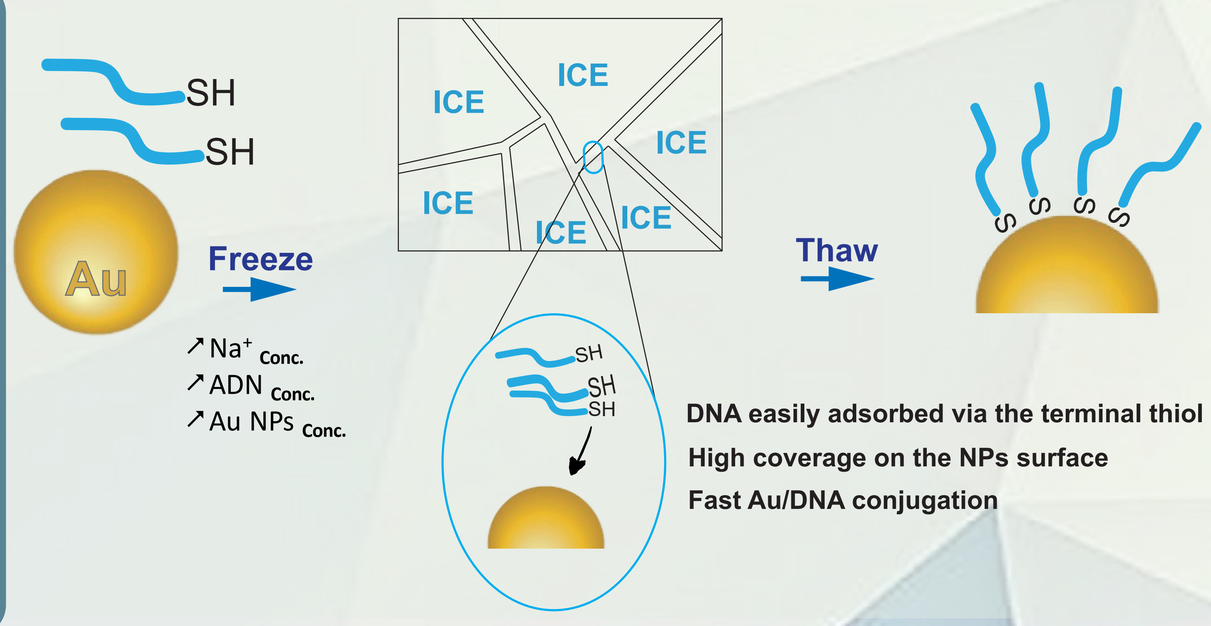
Bonding between the sulfur and gold surface

Sample name	Sequences	Number of nitrogen bases	Adenine%
S1	5'-SH-AAA AAA AAA AAA AAA AAA AA-3'	20	100%
S2	SH-ACC AAG ACG CAG	12	40%
S3	5'-C CCC AAA CCC-SH-3'	10	30%
S4	3'-SH-GAG AGC GGT GA-5'	11	17%
S5	5'-SH CCA CTC TTC ACA CCT CCT CCC ACT TCT TCC GTT GGG CAC GTG TTG TCT CTC TGT GTC TCG TGC CCT TCG CTA GGC CCA CA-3'	80	10%

Functionalization by Freeze-thaw method

Higher DNA density with higher colloidal stability

Freeze thaw method

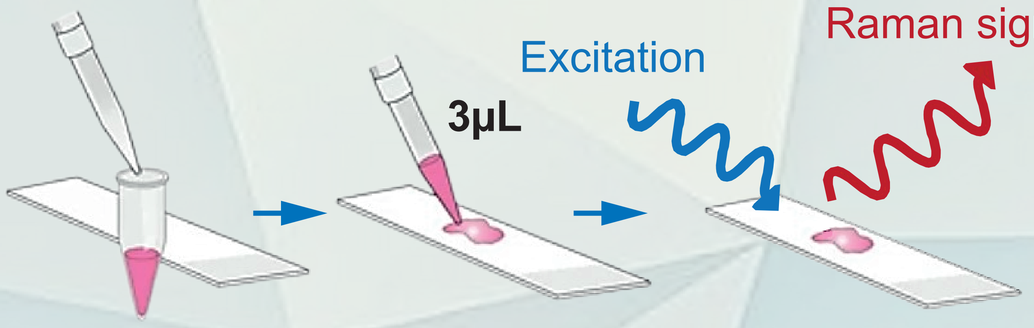


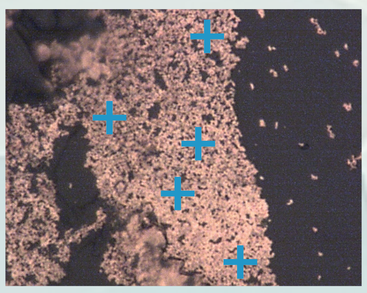
DNA easily adsorbed via the terminal thiol

High coverage on the NPs surface

Fast Au/DNA conjugation

SERS measurements

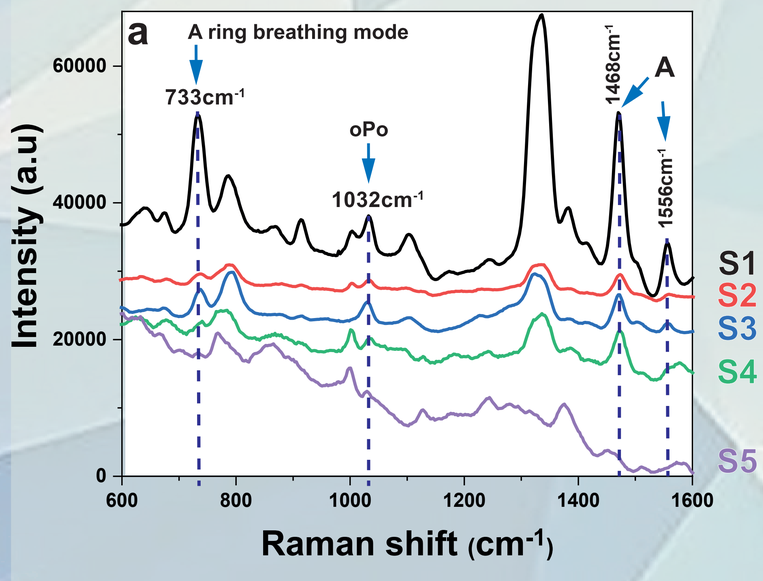


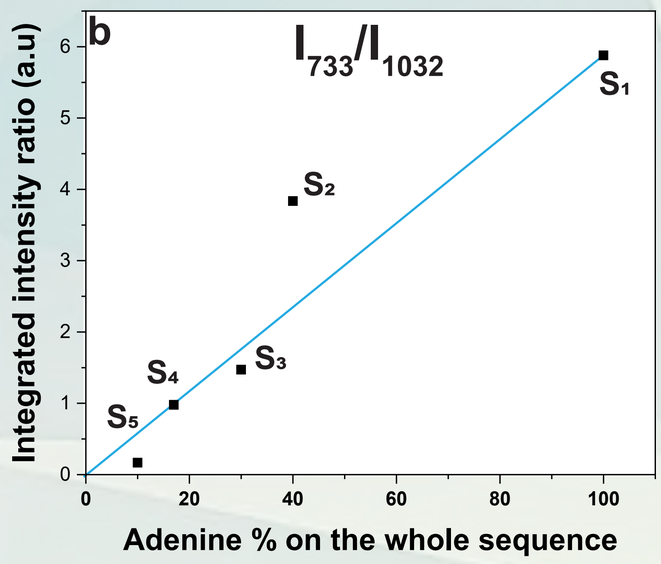


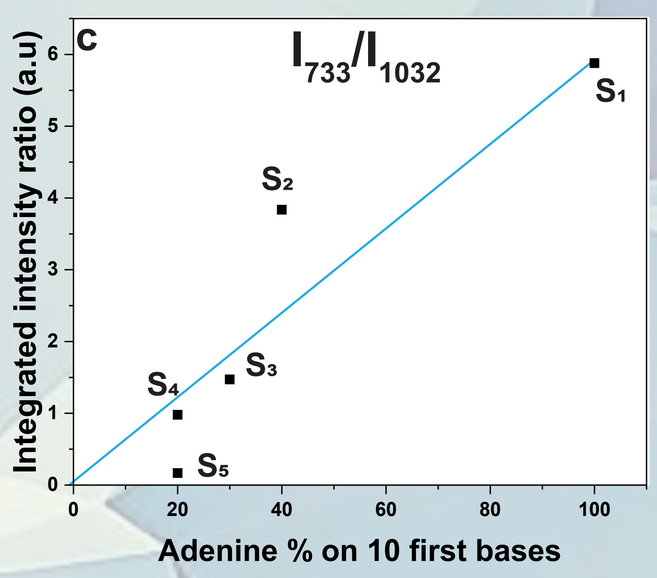
Optical microscope image x100

- SERS measurements on dry drop deposited on glass slide
- SERS spectra recorded with a x100 magnification objective (NA=0,8)
- Spectral calibration was performed on a crystalline silicon sample
- Excitation Wavelength: 785nm
- 5 SERS spectra/sample

Evolution of Raman signal vs Adenine %







a- The average SERS spectra show different bands, specifically the band at 733cm^{-1} assign to adenine and 1032cm^{-1} assign to phosphate backbone

b and c - I_{733}/I_{1032} versus the adenine percentage on the whole sequence (b) and on the 10 first bases (c)

Conclusions

The relative intensity of the 733cm^{-1} band is not perfectly correlated with the amount of adenine in the DNA sequence

Deviation of the relative intensity: distance of the bases from the gold surface / flexibility of the DNA strand ?

References

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Acknowledgements

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