



## Surface enhanced Raman spectroscopy (SERS) sensing in aqueous sample enabled by UV/ ozone treatment

Viehrig, Marlitt; Rindzevicius, Tomas; Zor, Kinga; Schmidt, Michael Stenbæk; Boisen, Anja

*Publication date:*  
2018

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*

Viehrig, M., Rindzevicius, T., Zor, K., Schmidt, M. S., & Boisen, A. (2018). Surface enhanced Raman spectroscopy (SERS) sensing in aqueous sample enabled by UV/ ozone treatment. Poster session presented at 44th International conference on Micro and Nano Engineering, Copenhagen, Denmark.

---

### General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



# Surface enhanced Raman spectroscopy (SERS) sensing in aqueous sample enabled by UV/ ozone treatment

Marlitt Viehrig<sup>1</sup>, Tomas Rindzevicius<sup>1</sup>, Kinga Zór<sup>1</sup>, Michael S. Schmidt<sup>1</sup>, Anja Boisen<sup>1</sup>

<sup>1</sup>The Danish National Research Foundation and Villum Foundation's Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics (IDUN), Department of Micro- and Nanotechnology, Technical University of Denmark, Kgs. Lyngby, Denmark.

We present the development of a detection strategy based on surface-enhanced Raman spectroscopy (SERS) sensing in water. The SERS substrates, fabricated from free-standing, gold-capped silicon nanopillars are commonly used for the detection of analytes dissolved in organic solvents and dried on the sensor surface. We developed a method where detection can be performed directly in aqueous samples using a model drug acetoaminophene (Paracetamol).

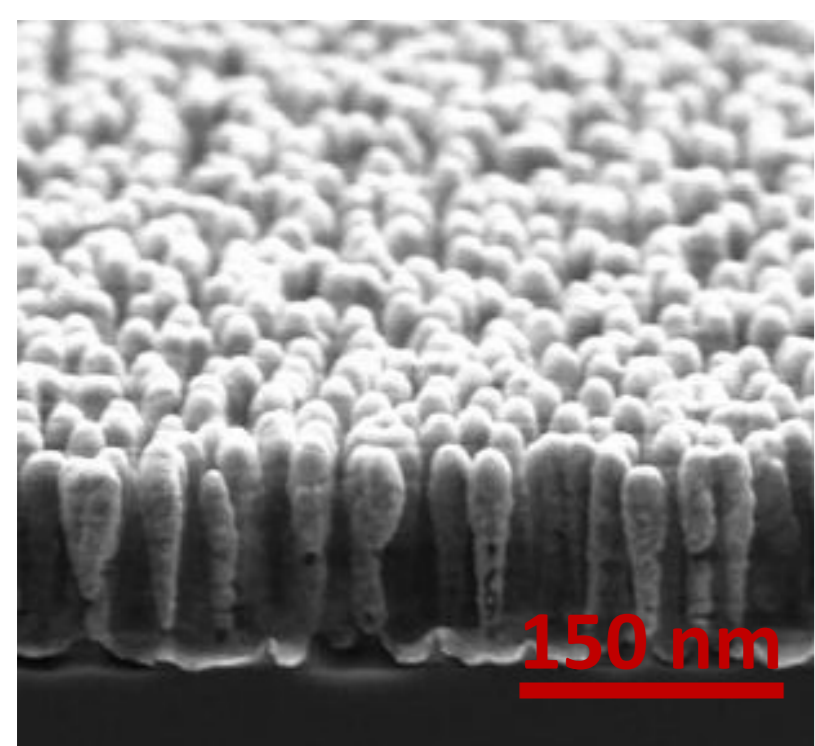
## SERS sensing in Water



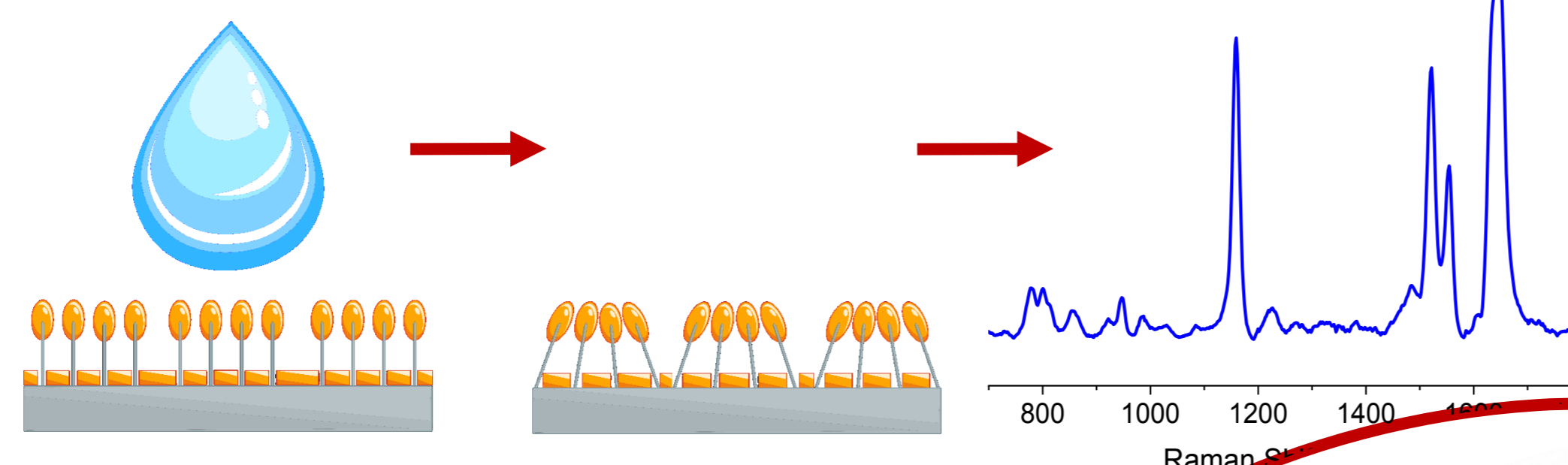
Pharmaceuticals have become integral parts of our daily life. However, this widespread availability poses a potential risk of leakage into our environment leading to possible disturbances in various eco systems. Even though low concentrations of single drugs are not necessarily harmful, cross-reactions with other drugs and accumulation can be dangerous if not carefully monitored.

### SERS Substrate - Gold Capped Nanopillars

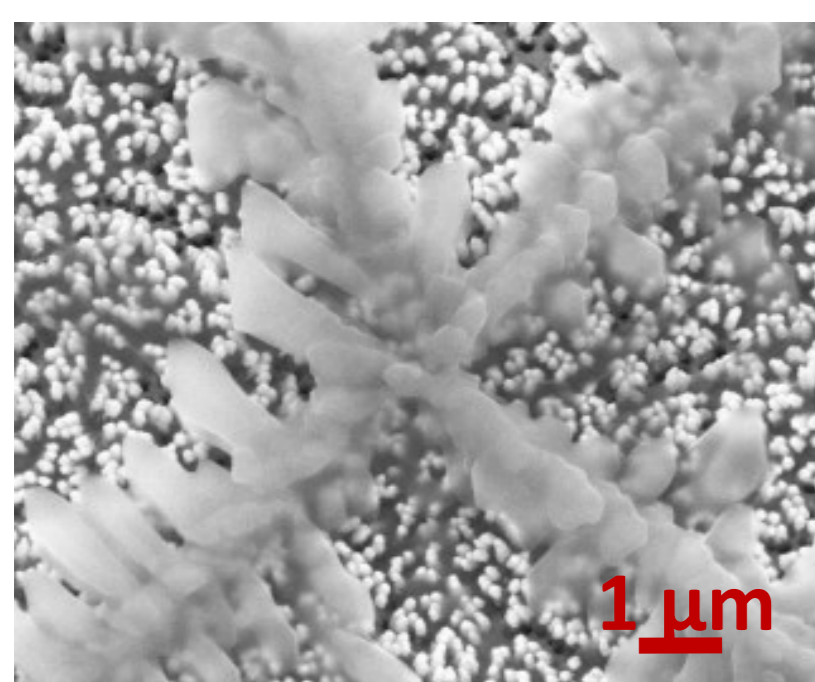
SERS is a powerful analysis technique capable of detecting molecular fingerprints of analytes with high sensitivity and fast response time. [2]



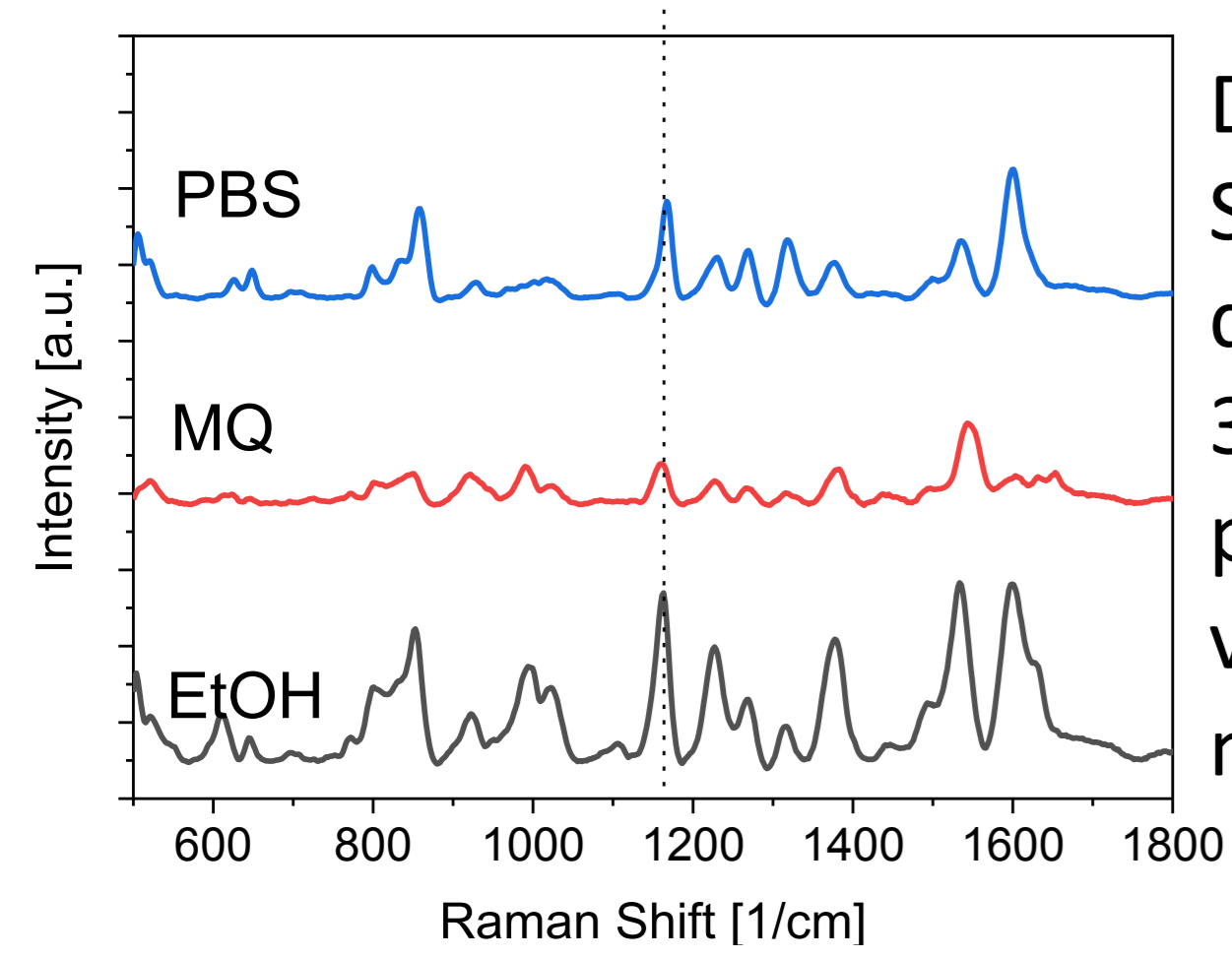
Silmeco ApS



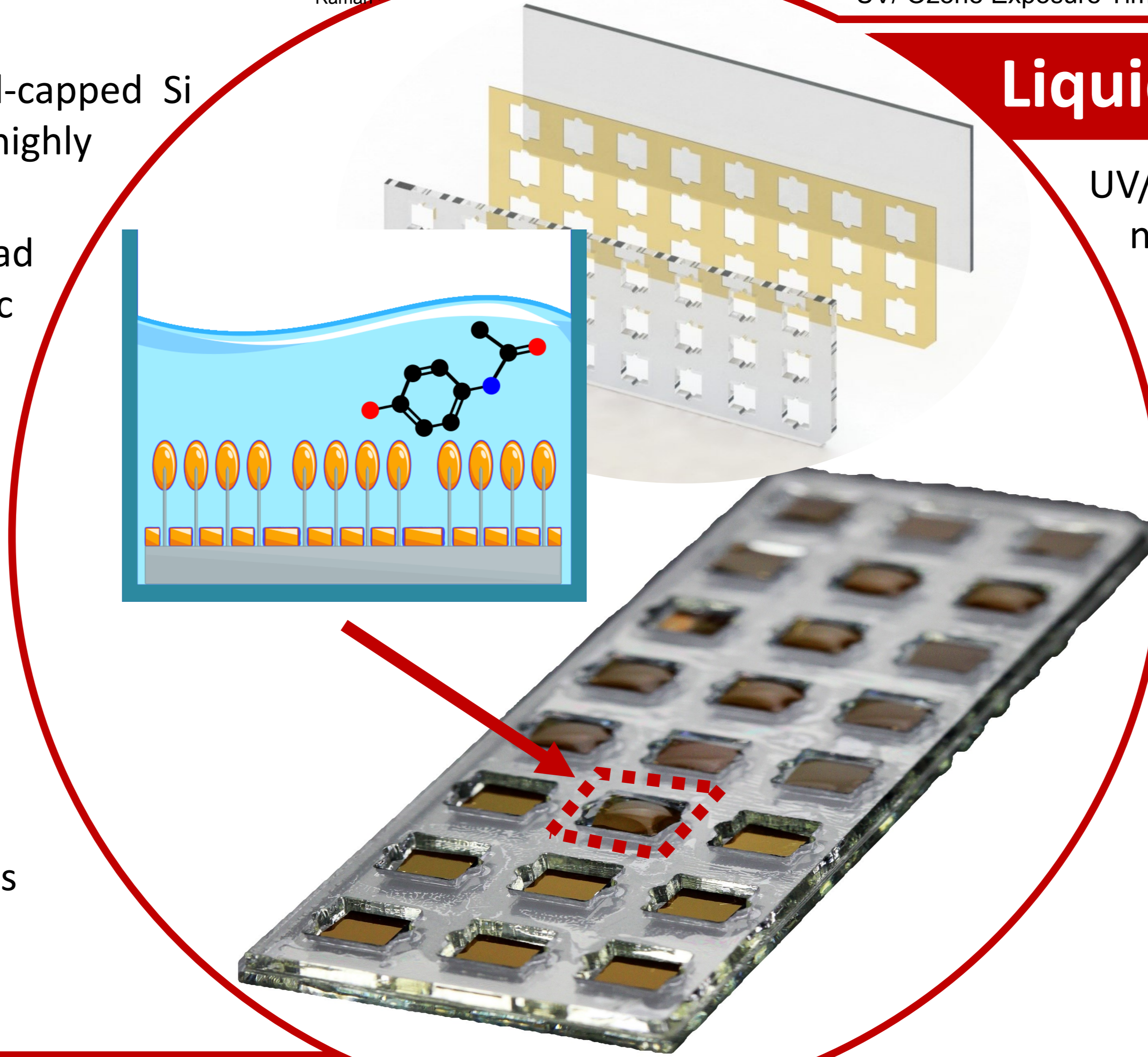
Classical dry droplet SERS sensing using gold-capped Si nanopillars. [3] Dry droplet measurements are highly influenced by the chosen sample matrix.



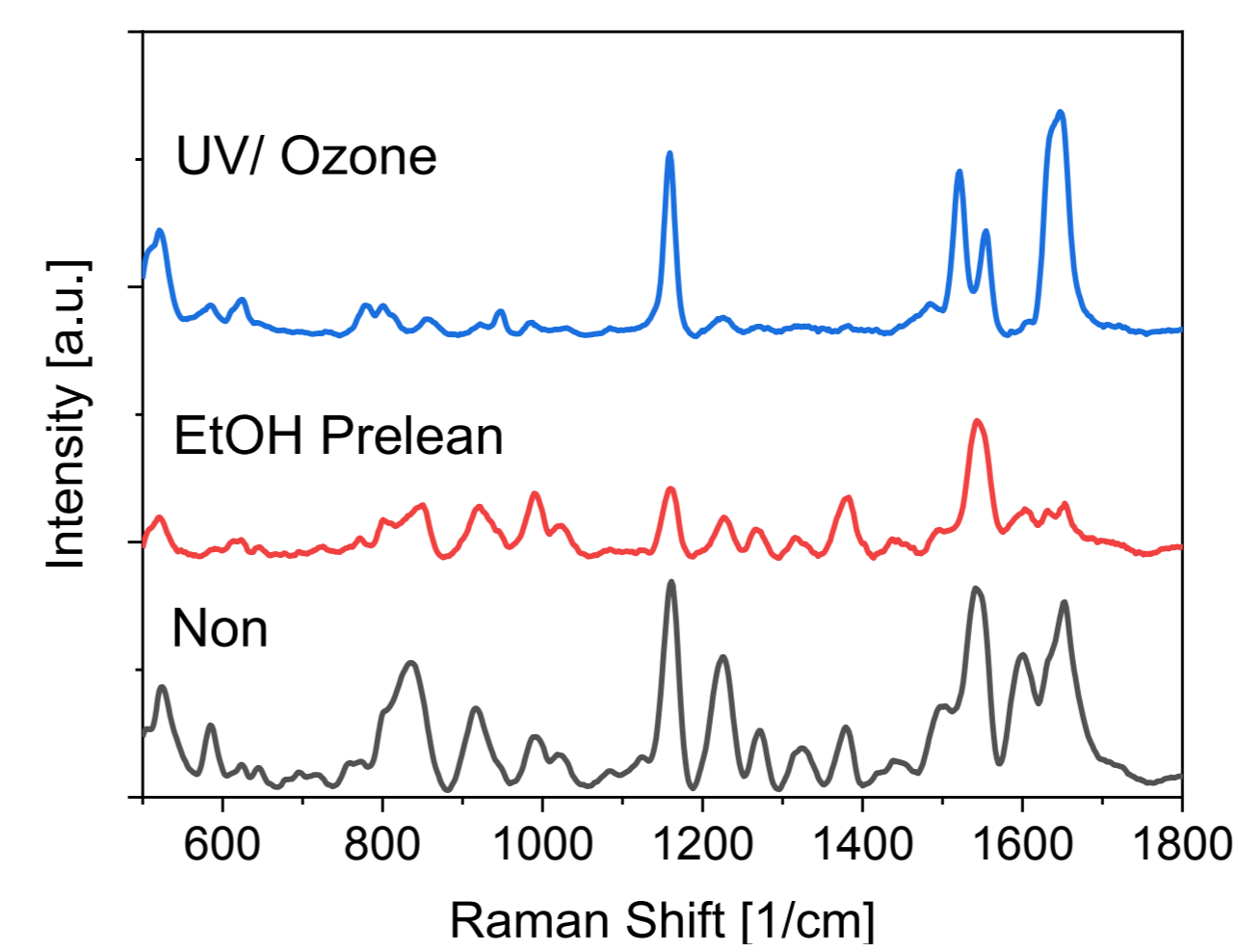
Complex matrices can lead to sensor fouling. Organic solvents are preferred, due to the **hydrophobic nature of the nanopillar surface**.



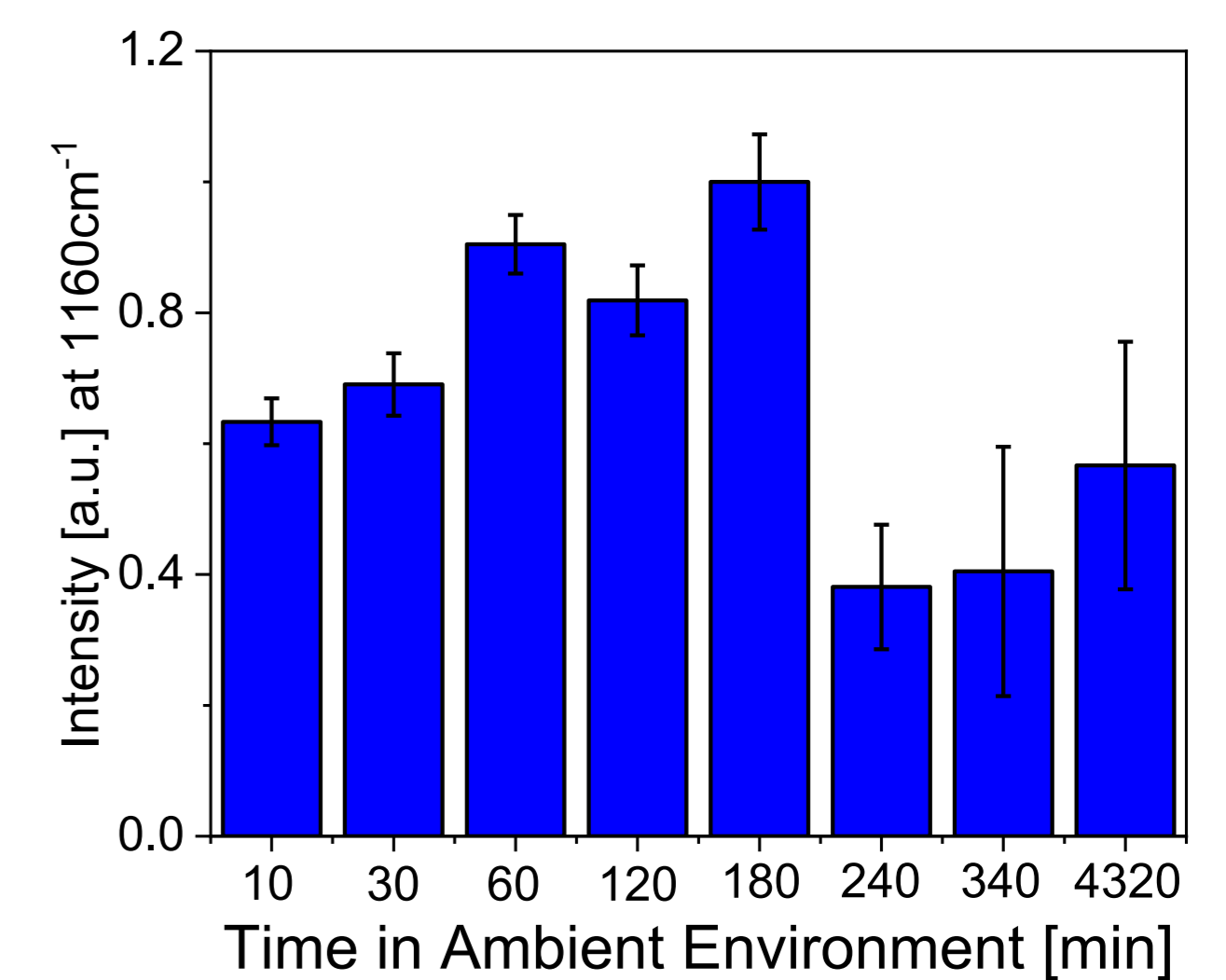
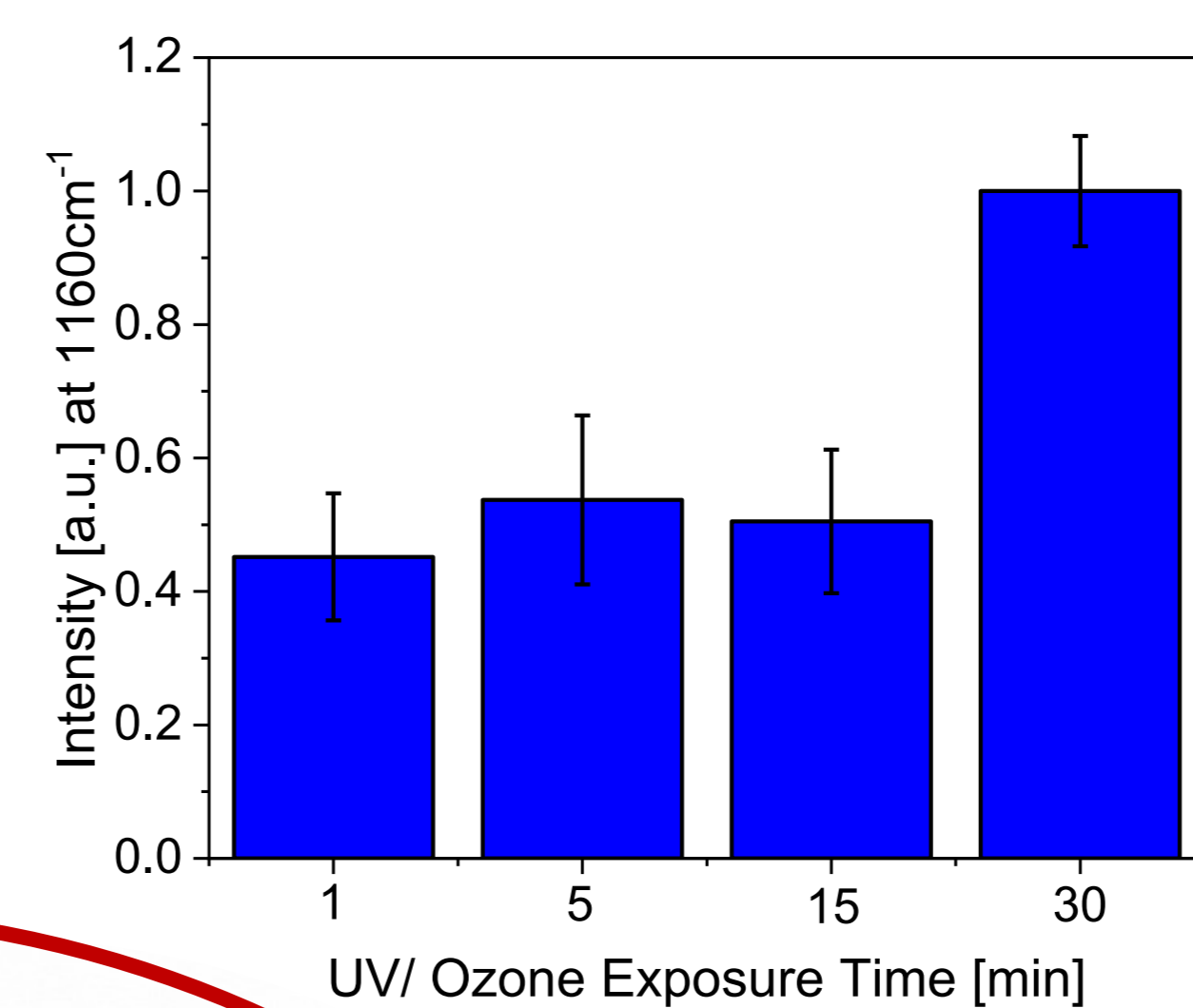
Dry droplet SERS-based detection of 350 μM paracetamol in various aqueous matrices.



## UV/ Ozone Treatment

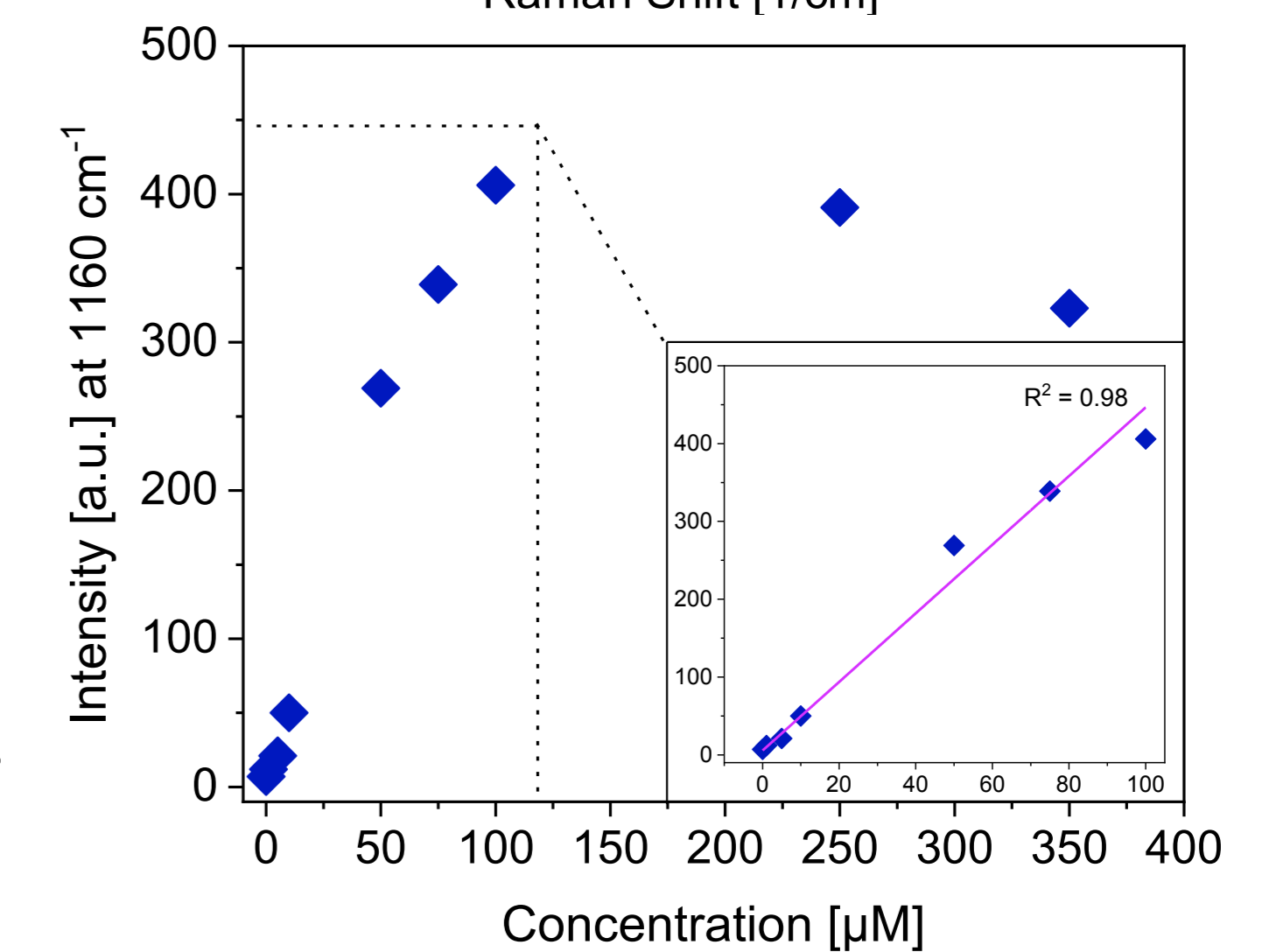
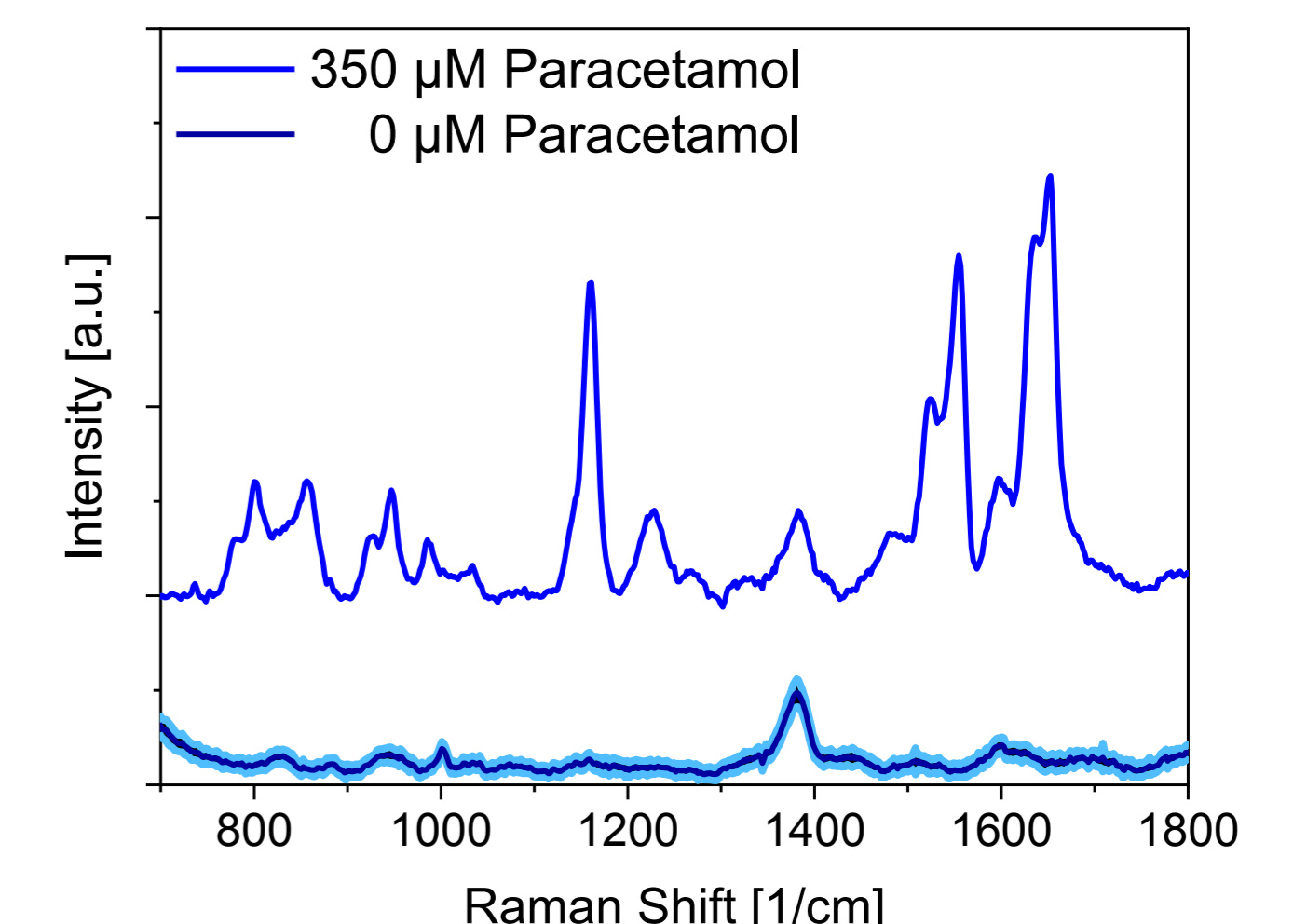


UV/ ozone surface treatment resulted in a lowered background signal, more defined peak shape and homogenous wettability in aqueous samples in comparison to untreated and pre-leaned samples. Optimal signals were obtained after **30 min** of treatment and samples were stable for **3 hrs** in an ambient environment.



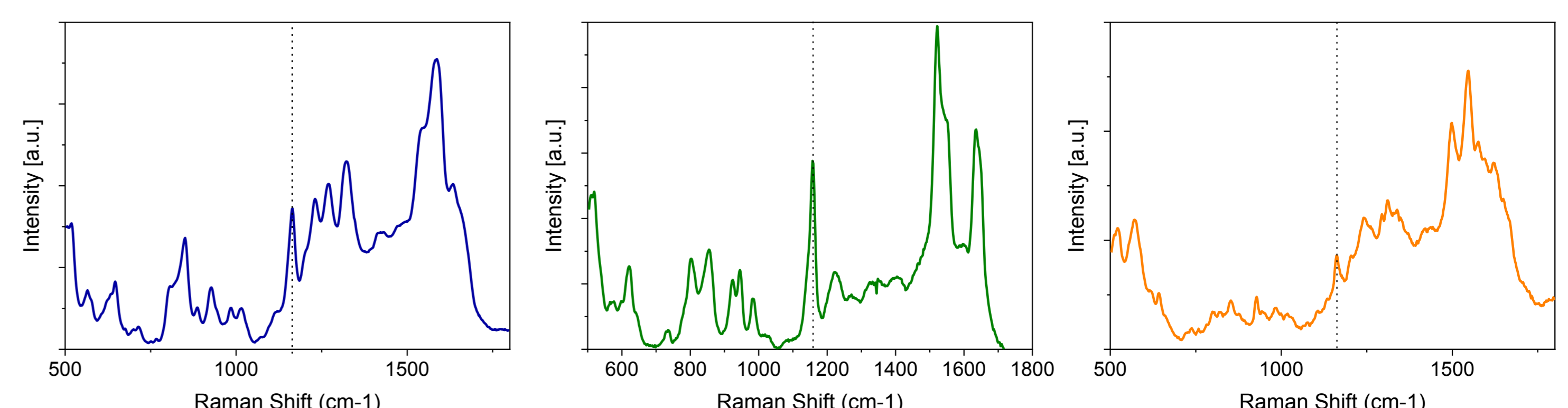
## Liquid Measurements

UV/ ozone treatment enabled the development of a novel liquid measurement technique for nanopillar SERS based sensing.



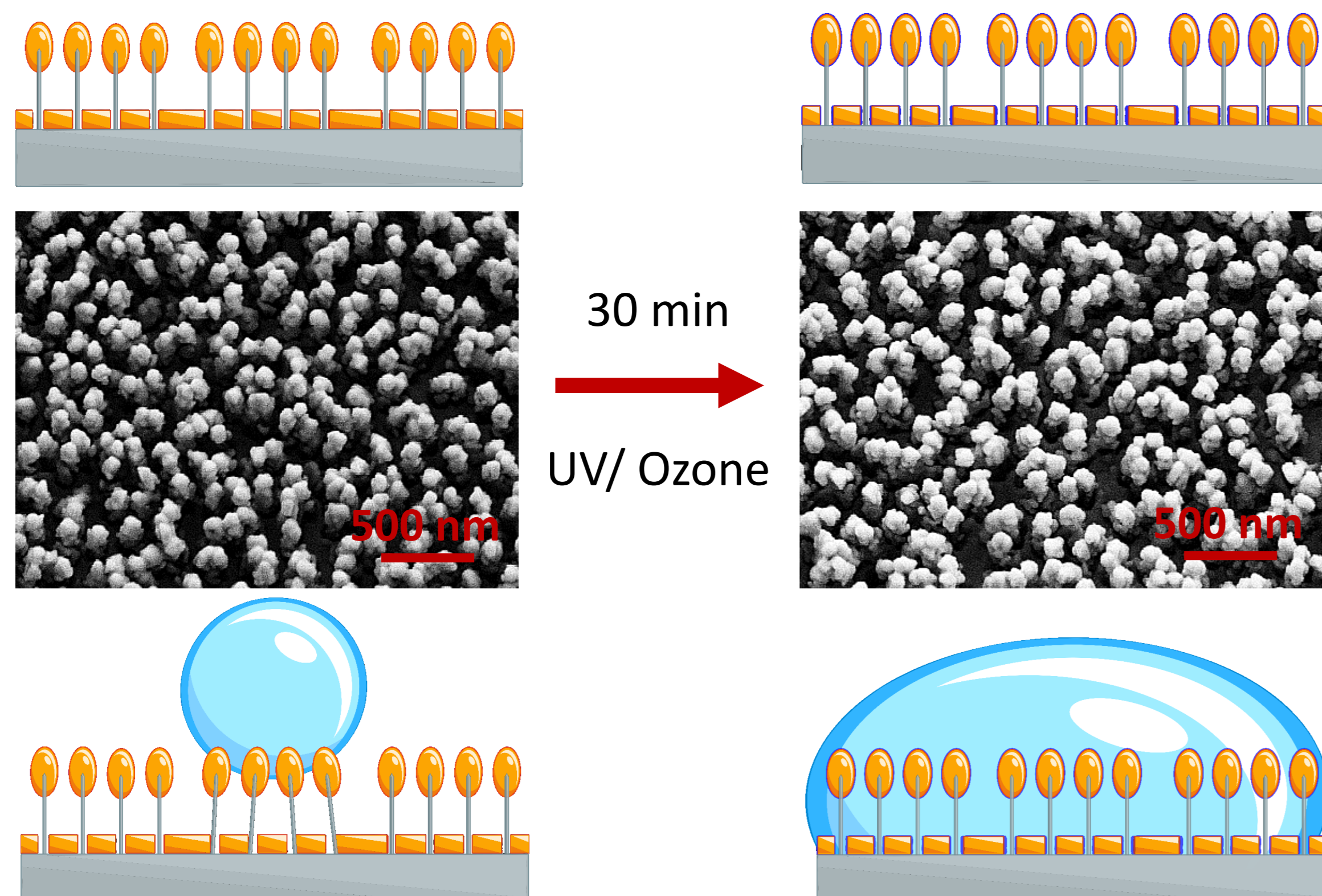
Direct Paracetamol detection in MQ was possible over a linear range of **5 – 100 μM**.

350 μM Paracetamol spiked in **PBS, tap water** and unfiltered **river water** shows that UV/ Ozone pre-treatment allows detection in a realistic environment.



## Surface Treatment

UV/ ozone exposure is commonly utilized as surface treatment and cleaning procedure in a variety of microfabrication processes. It renders the surface of gold-capped nanopillars from hydrophobic to hydrophilic without any morphological alterations.



### Acknowledgement

This work was financially supported by the IDUN Center of Excellence funded by the Danish National Research Foundation (Grant No. DNR122) and the Villum Fonden (Grant No. 9301).

### References

- [1] A. B. A. Boxall. "The environmental side effects of medication" in European Molecular Biology Organization, 2004, pp. 1110-1116
- [2] G. C. Schatz, M. A. Young, and R. P. Duyn, "Electromagnetic Mechanism of SERS," in Surface-Enhanced Raman Scattering, Springer Berlin Heidelberg, 2006, pp. 19-45.
- [3] M. S. Schmidt, J. Hübner, and A. Boisen, "Large Area Fabrication of Leaning Silicon Nanopillars for Surface Enhanced Raman Spectroscopy," Adv. Mater., vol. 24, no. 10, p. OP11-OP18, Mar. 2012.

