

# Ultrasound-Induced Defect Engineering in $\text{TiO}_2\text{-x}$ Nanotubes for Highly Efficient Photocatalytic Water Splitting with Platinum Single-Atom Enhancement

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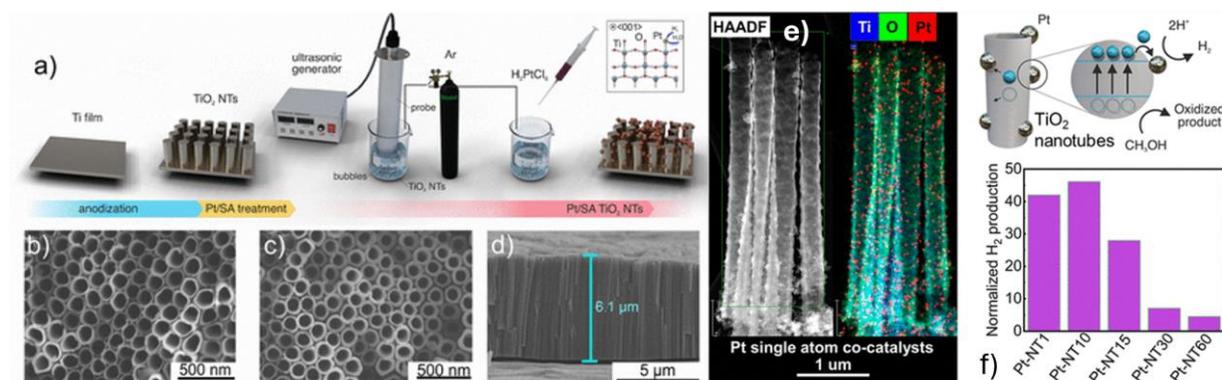
## INTRODUCTION

This study presents a novel ultrasound-driven strategy for stabilizing Pt single-atomic sites over  $\text{TiO}_2$  nanotubes. This controllable low-temperature defect engineering enables entrapment of platinum single atoms and controlling their content through the reaction time of consequent chemical impregnation. The novel methodology enables achieving nearly 50 times higher normalized hydrogen evolution compared to pristine titania nanotubes.

## EXPERIMENTAL/THEORETICAL STUDY

Titania nanotubes (TNTs) were prepared by anodization (70 V, 30 min, room temperature) in a standard two-electrode cell, with a titanium and a platinum foil as the working and the counter electrode, respectively. Reduced TNTs were fabricated through sonication in a beaker filled with 100 mL of DI water and in an Ar atmosphere. Immediately after reduction, to decorate Pt single atoms, reduced TNTs were immersed in  $\text{H}_2\text{PtCl}_6 \cdot 6\text{H}_2\text{O}$  solution for different times (1, 10, 15, 30, 60 min)<sup>1</sup>.

## RESULTS AND DISCUSSION



**Fig. 1** a) Schematic illustration presenting the fabrication strategy of Pt-SA TNTs. SEM image of b) pristine TNTs, c) sonicated sample, d) cross section. e) EDS elemental mapping Pt-SA loaded sample. f) Mechanism of photocatalytic hydrogen evolution using ultrasound-reduced TNTs with embedded Pt single-atom co-catalysts and normalized  $\text{H}_2$  evolution of SA-Pt catalysts.

## CONCLUSION

The single-atom engineering based on the creation of ultrasound-triggered chemical traps provides a pathway for controllable assembling stable and highly active single-atomic site catalysts on metal oxide support layers.

## REFERENCES

1. M. Shahrezaei, S. M. H. Hejazi, H. Kmentova et. al, ACS Appl. Mater. Interfaces 15, 37976–37985 (2023).

## ACKNOWLEDGEMENTS

The work was supported by the European Union's Horizon 2020 project SAN4Fuel (No. 101079384, Horizon-Widera-2021) and from ERDF/ESF project TECHSCALE No. CZ.02.01.01/00/22\_008/0004587).