Fabricating Solid State Gas Sensors by Aerosol-based Techniques

George Biskos

Department of Chemical Engineering, Delft University of Technology, The Netherlands
Department of Environment, University of the Aegean, Greece
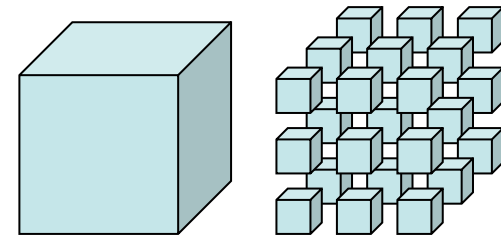
May 24, 2013

UNIVERSITY
OF THE AEGEAN

T U Delft

Delft University of Technology

Motivation

- Gas Sensors
  - Emissions control and safety
  - Diagnostics

Need to go Nano

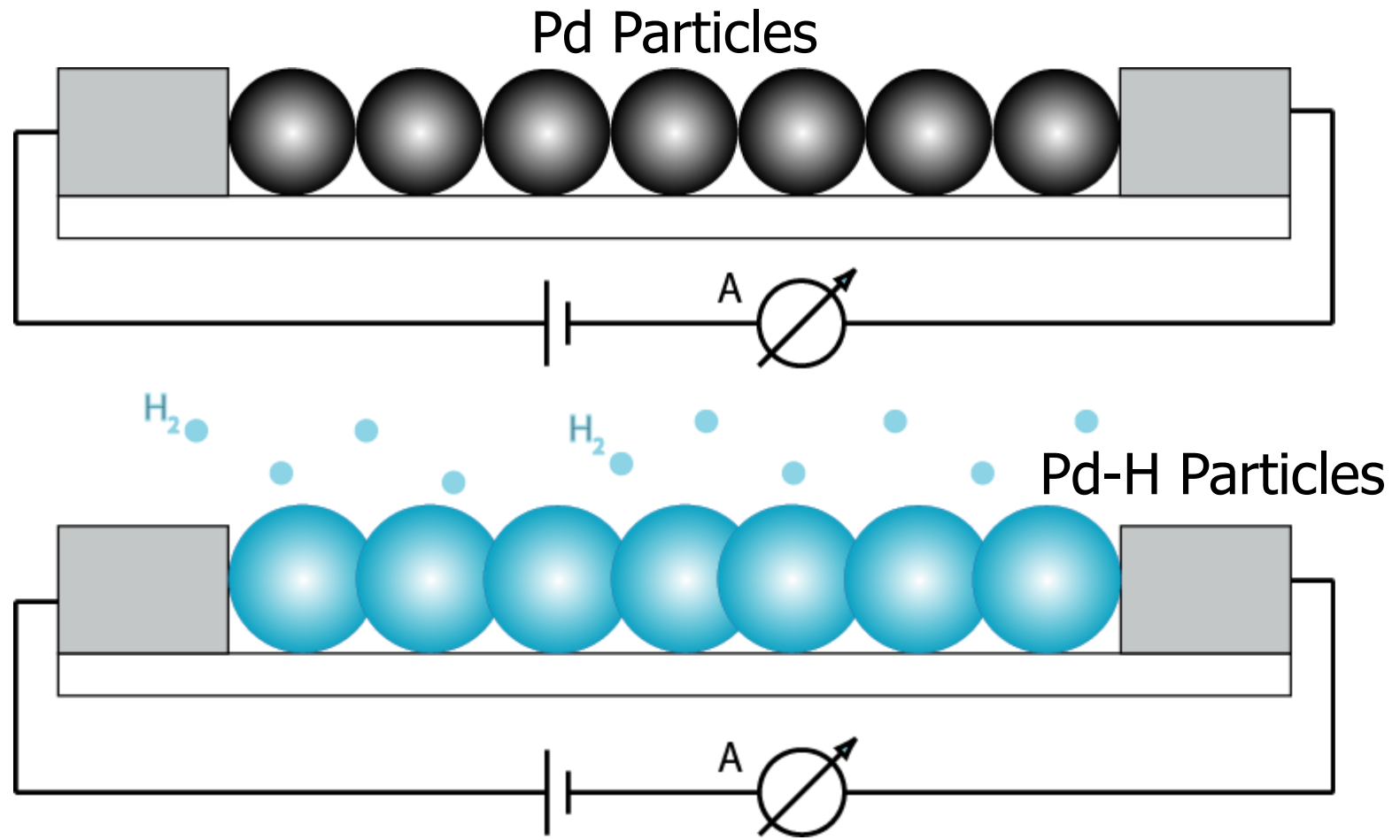- Aerosol-based Techniques for Synthesizing Nanomaterials
  - Good control over particle size, morphology and composition
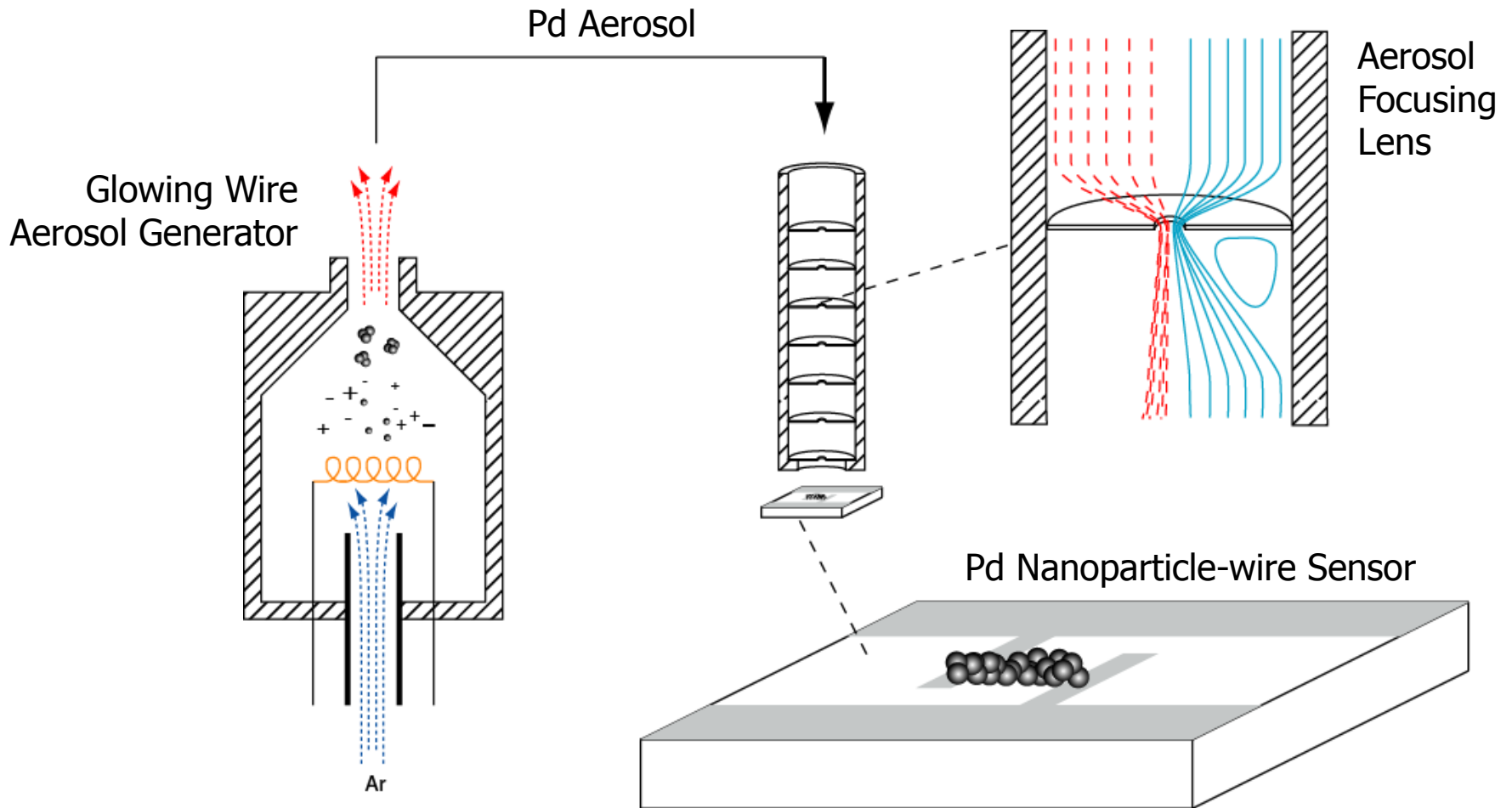 - Tools for assembling nanostructures

UNIVERSITY
OF THE AEGEAN

TUDelft

Nanoparticles Synthesis in the Gas Phase

- [Evaporation/Condensation](#)
    - Tube Furnaces
    - Spark Discharges
        - Glowing Wires

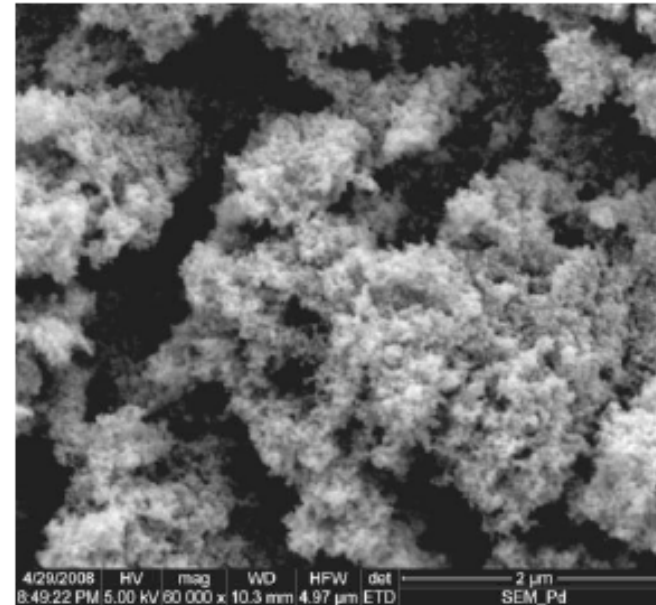- [Solution Spray](#)
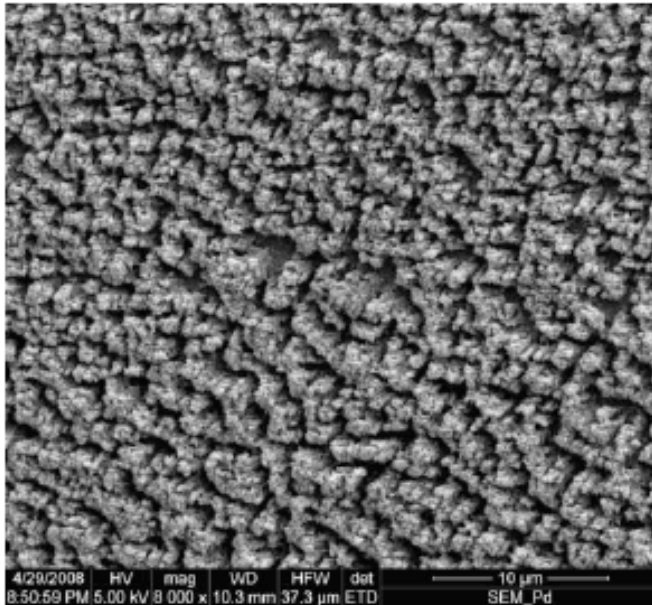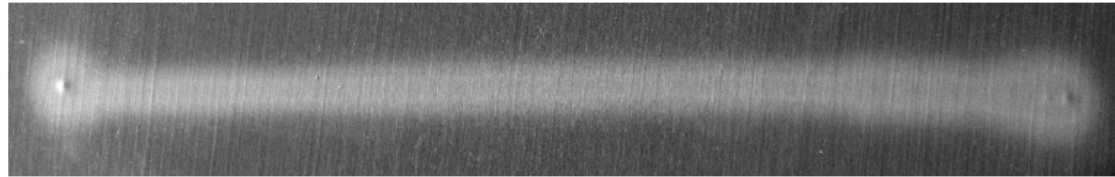   - Atomization
    - Electrospray
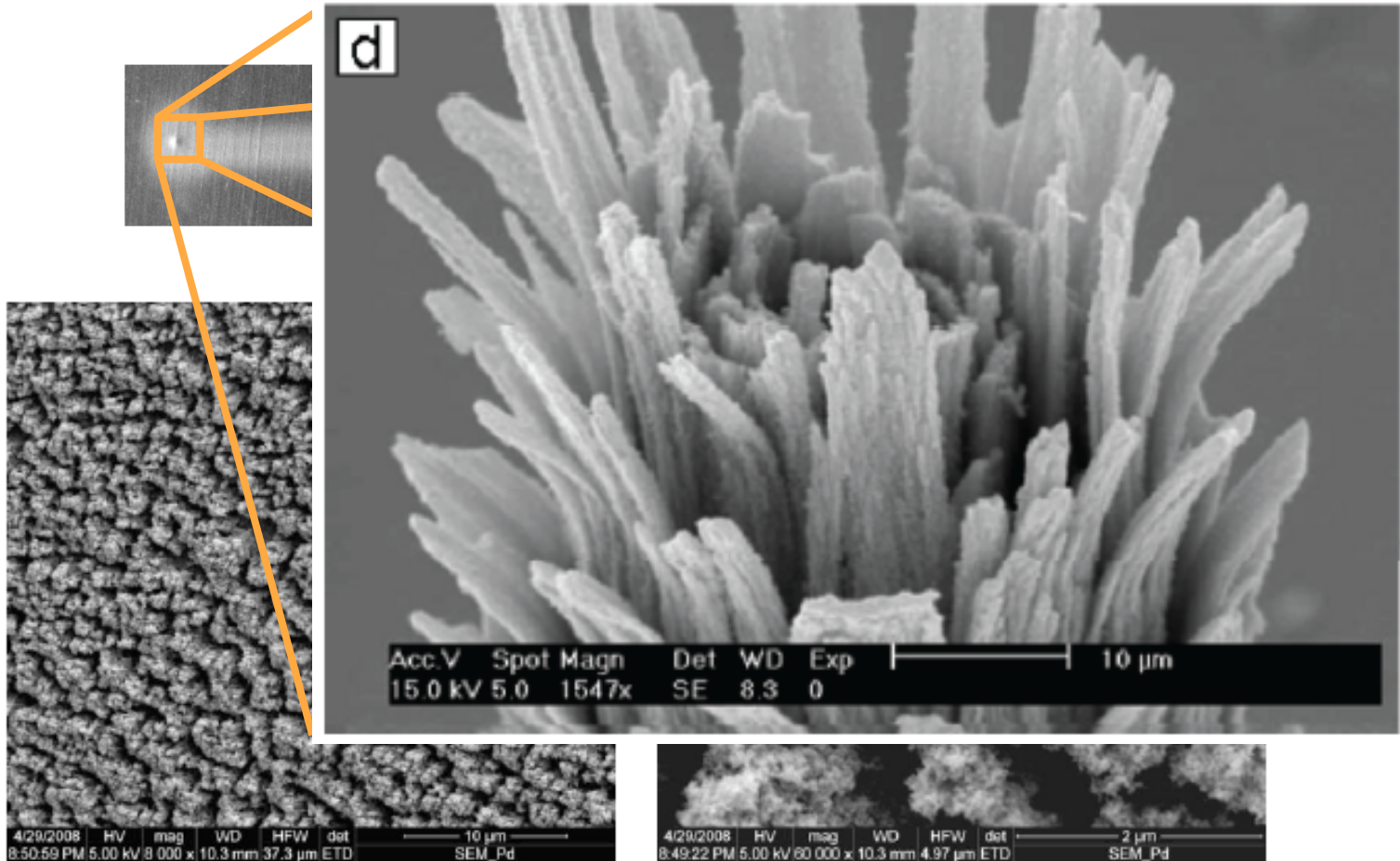
- [Flame Syntehsis](#)

H₂ Sensor base on Pd Nanomaterials

Fabrication of a Pd-based Nanomaterials

Pd Aerosol

Glowing Wire Aerosol Generator

Aerosol Focusing Lens

Pd Nanoparticle-wire Sensor

Ar

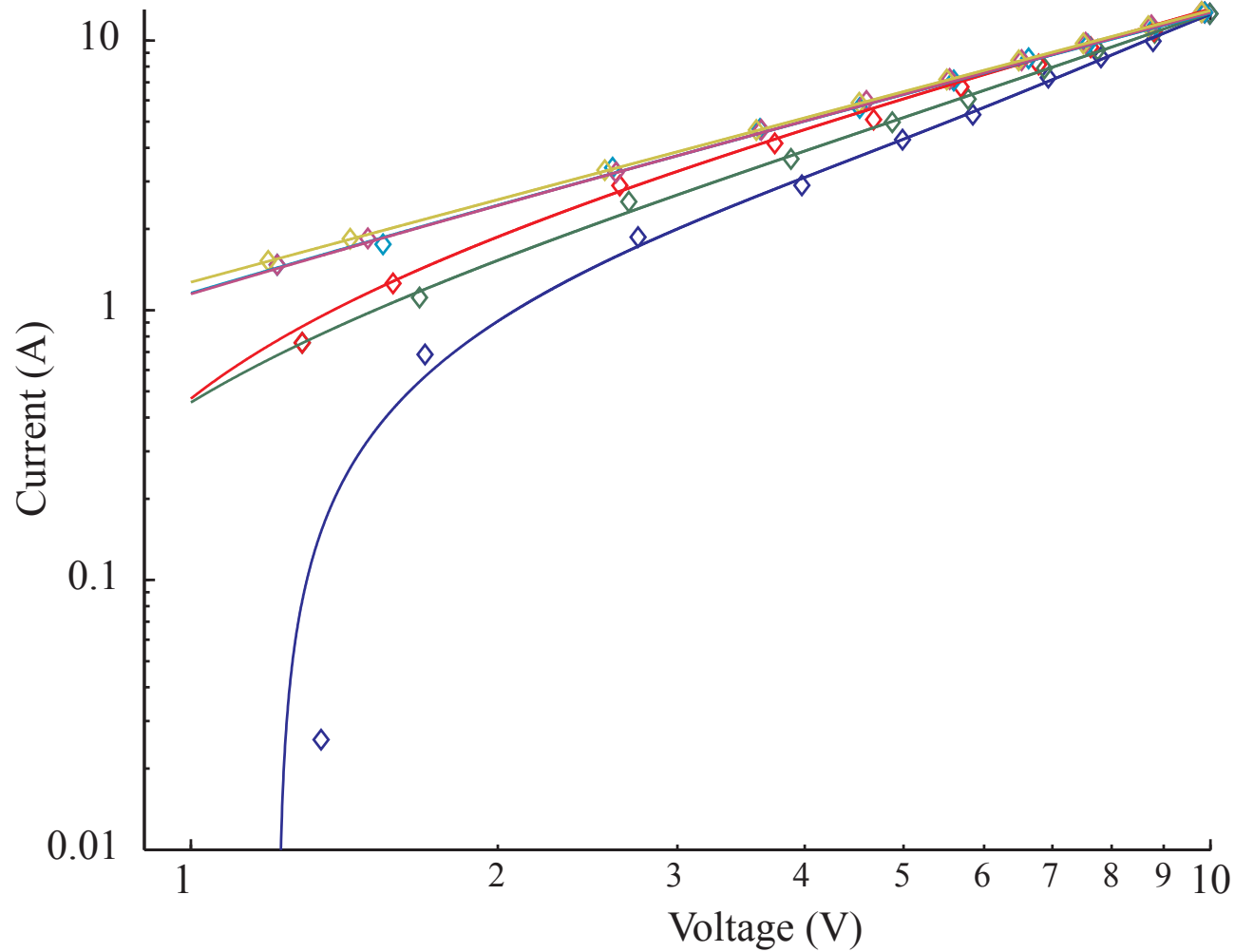UNIVERSITY OF THE AEGEAN

TUDelft

Structure of the Pd-based Nanomaterial

Structure of the Pd-based Nanomaterial

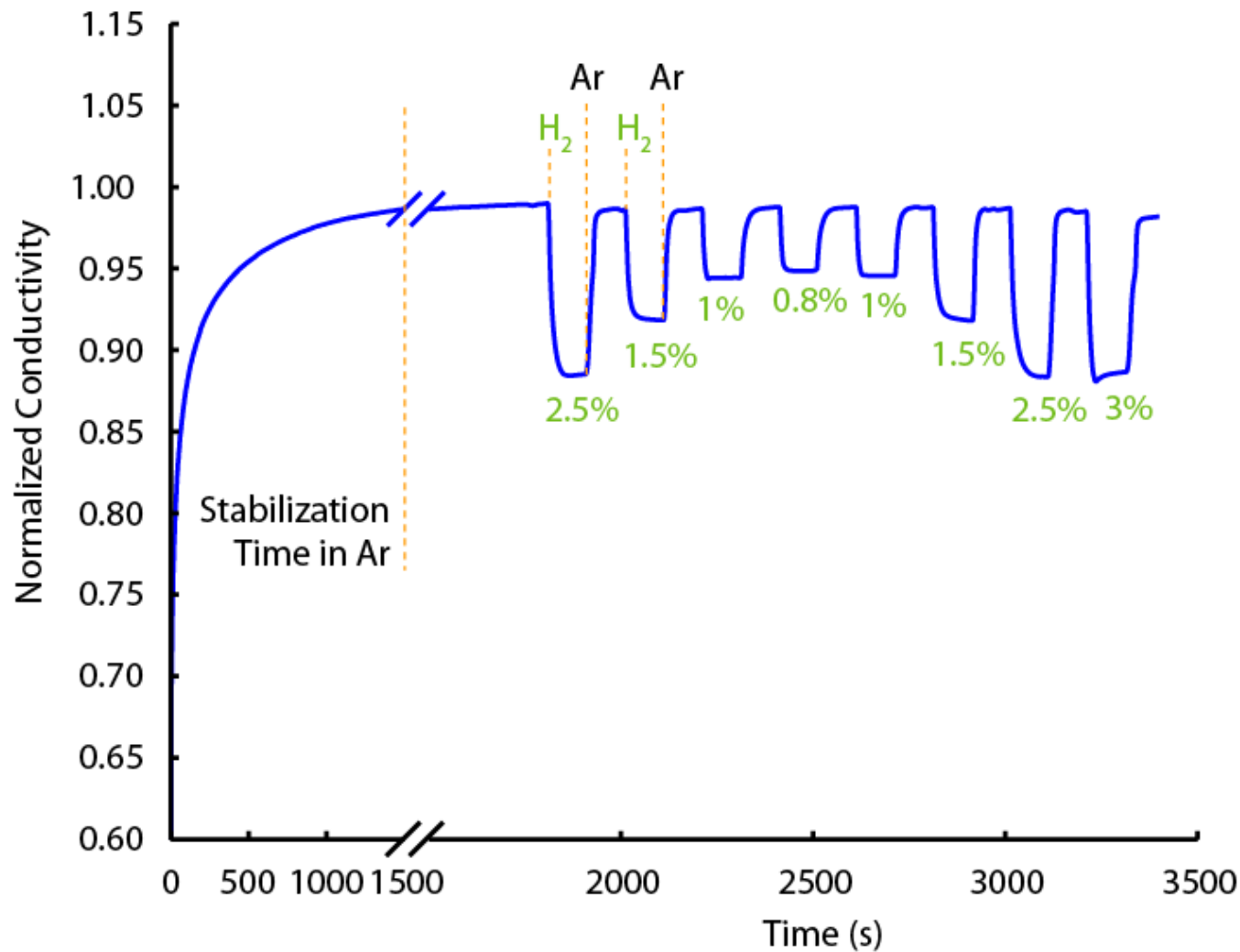# Stabilization of the Structure

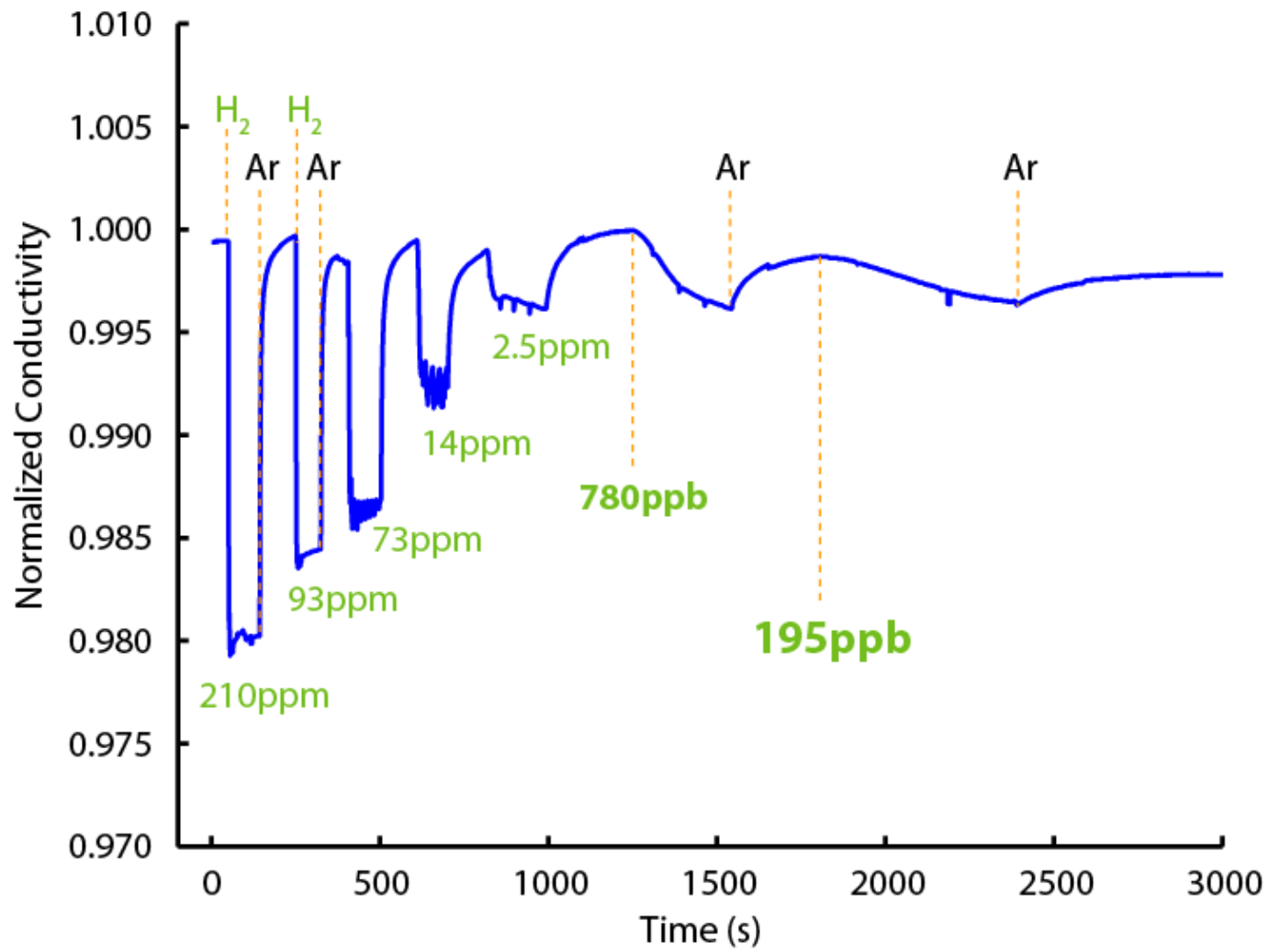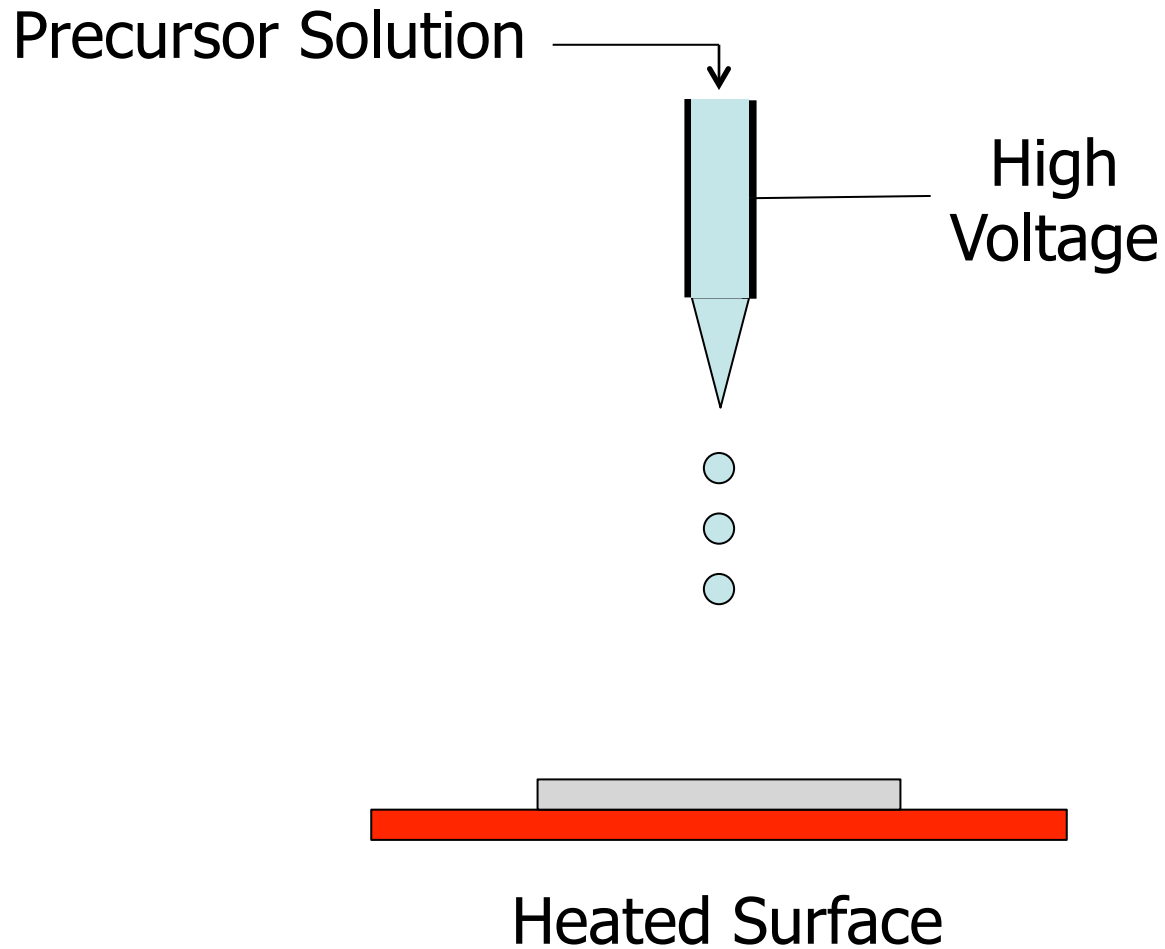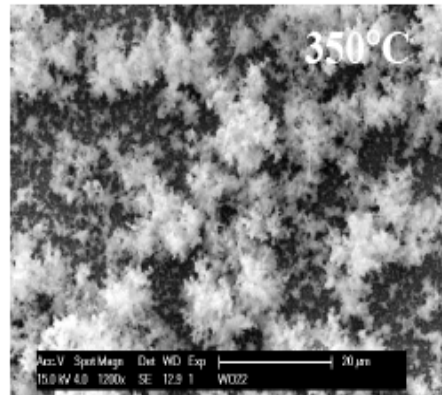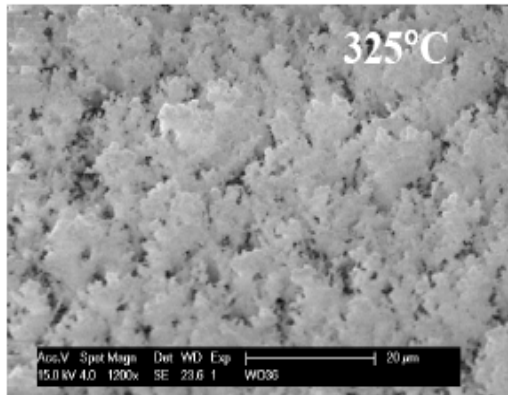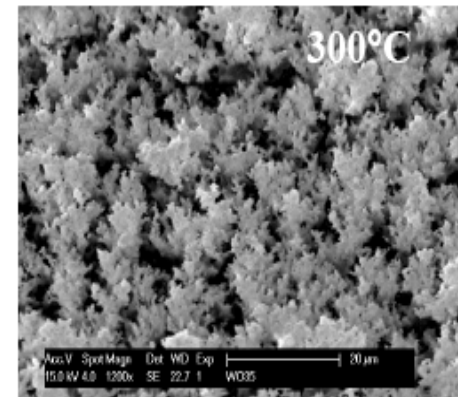# Response of the Pd Nanoparticle H₂ Sensor

Sensitivity of the H₂ Sensor

Electrospray Deposition

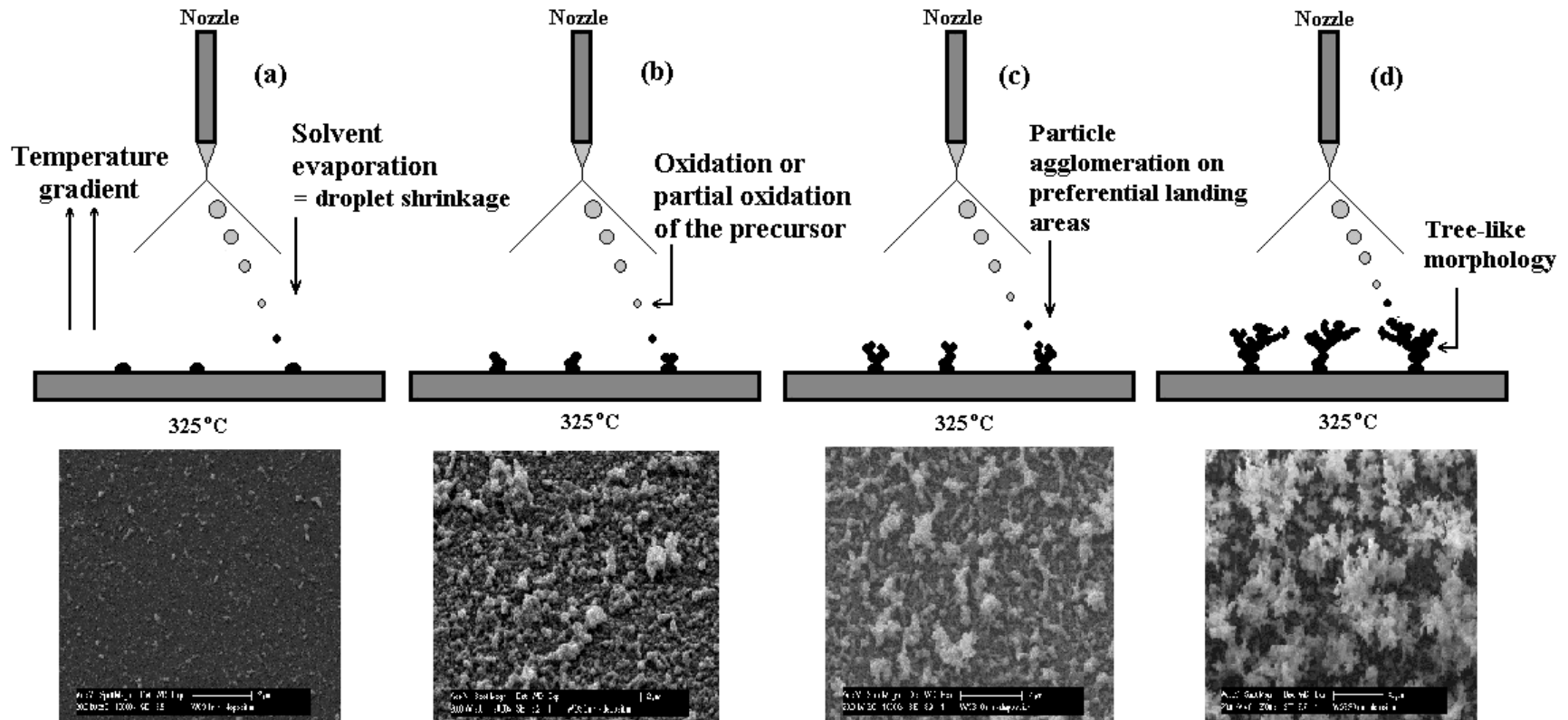Precursor Solution

High Voltage

Heated Surface

Temperature-dependent Morphology Changes of WO₃ Nanostructures

UNIVERSITY
OF THE AEGEAN

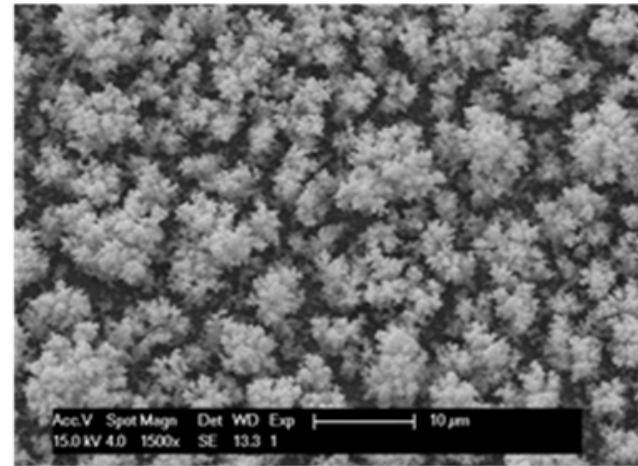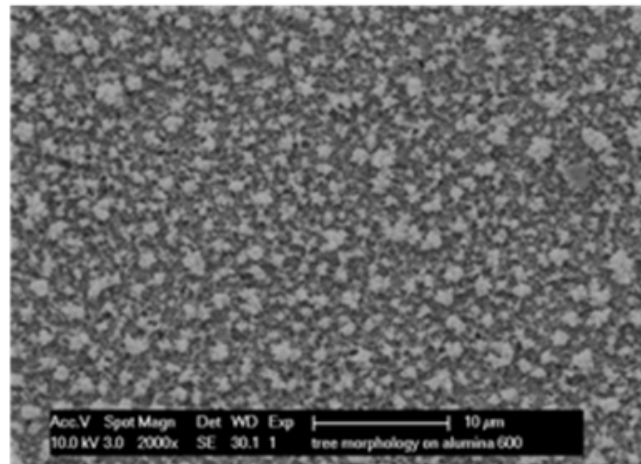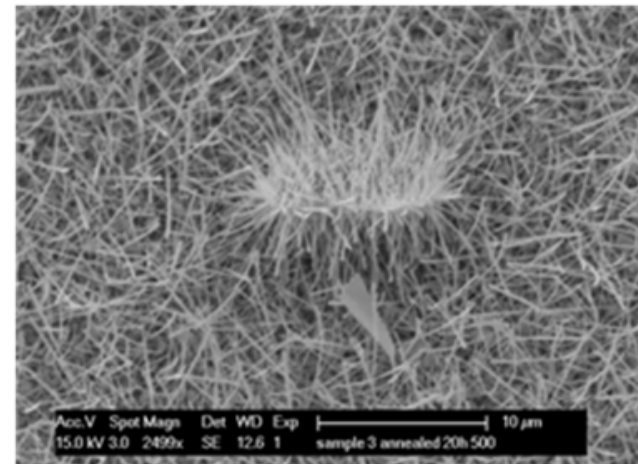TUDelft
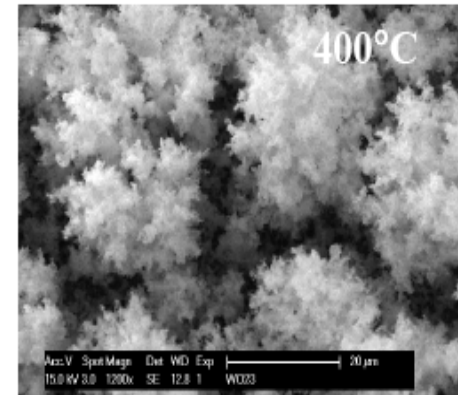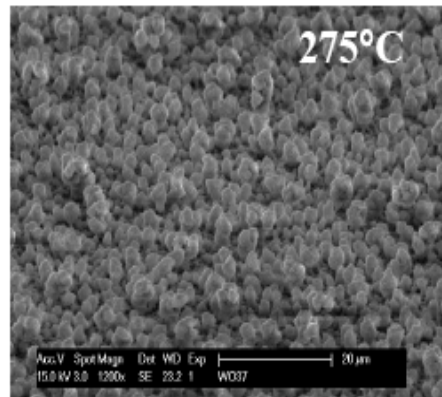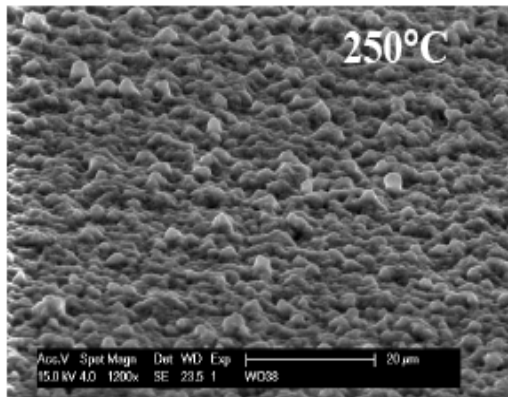
Electrospray/Electrostatic Deposition
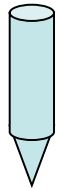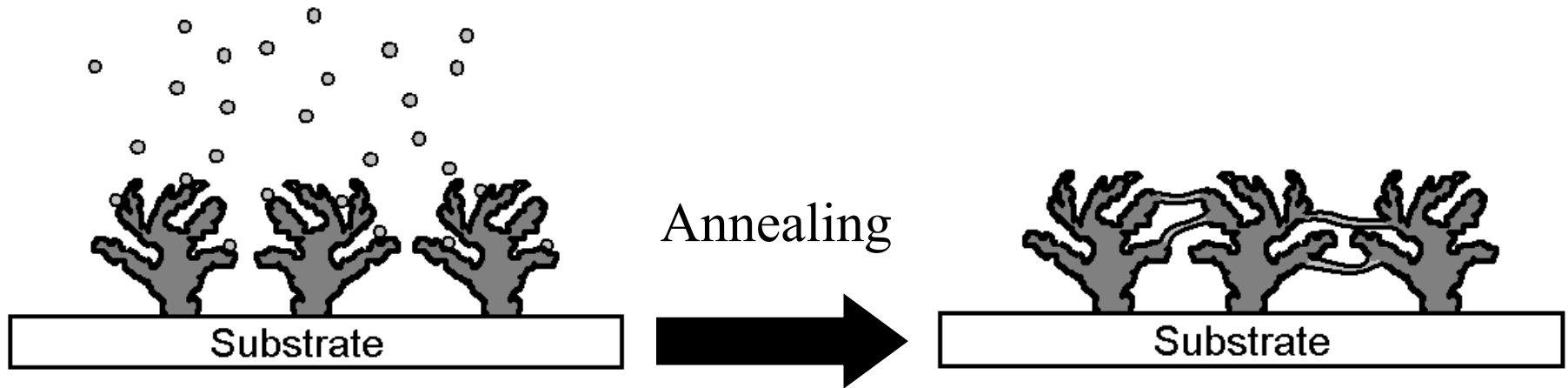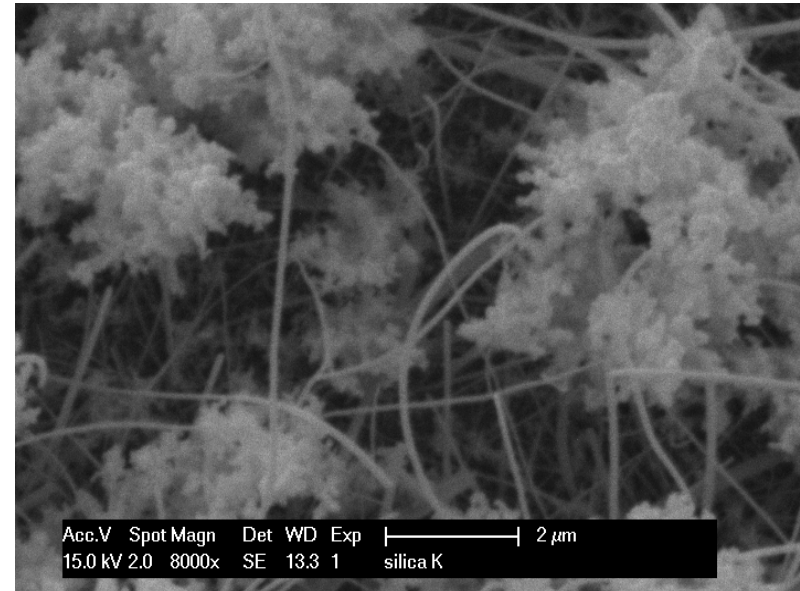
Growth of Nanowires

Aluminum foil
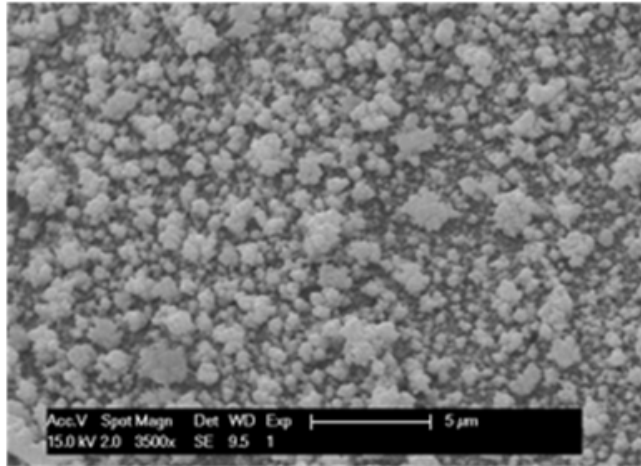
Silicon wafer

Alumina

Glass

UNIVERSITY
OF THE AEGEAN

TUDelft

Controlling the Growth of Nanowires

Post-deposition of KOH
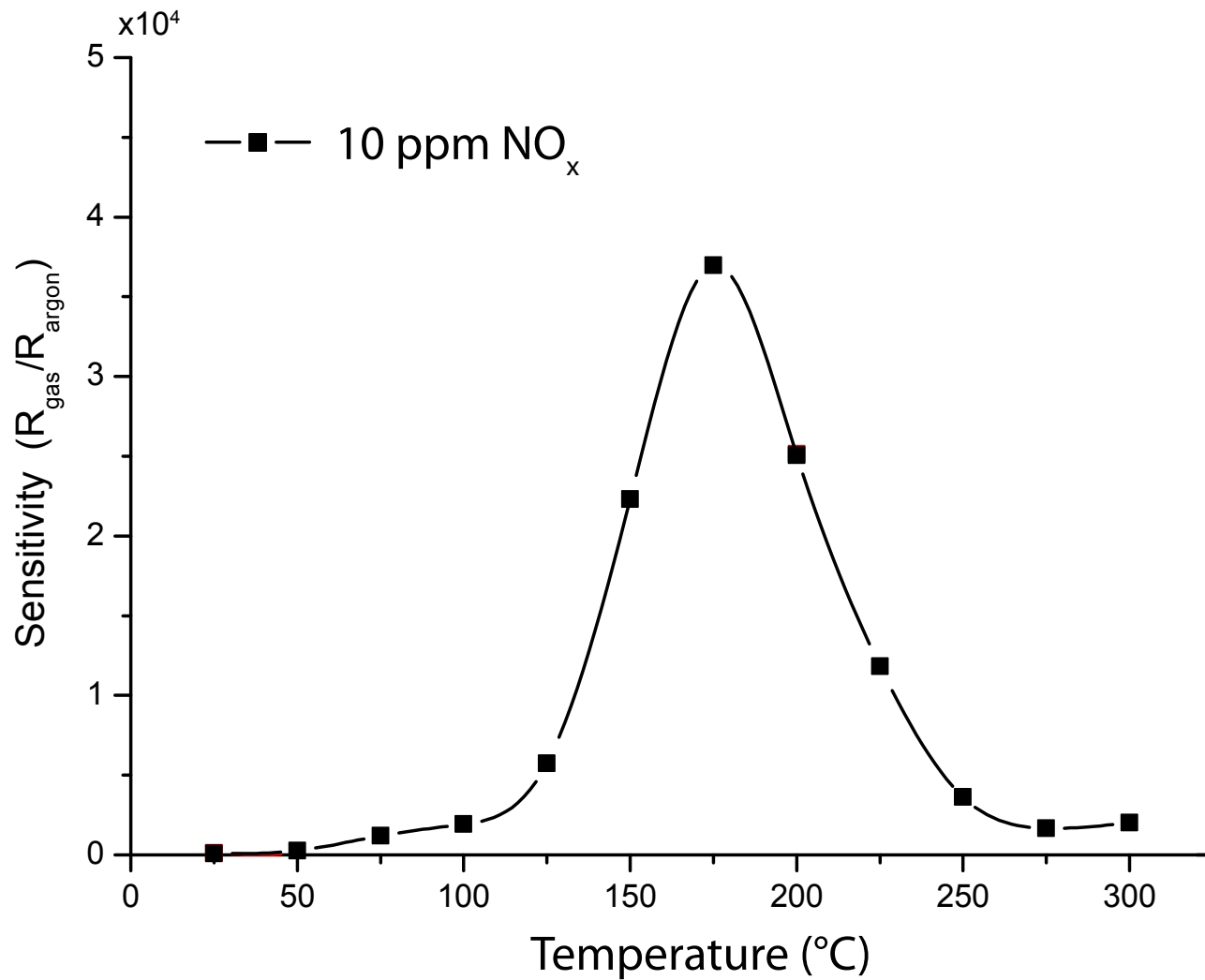
Annealing

Substrate

Substrate
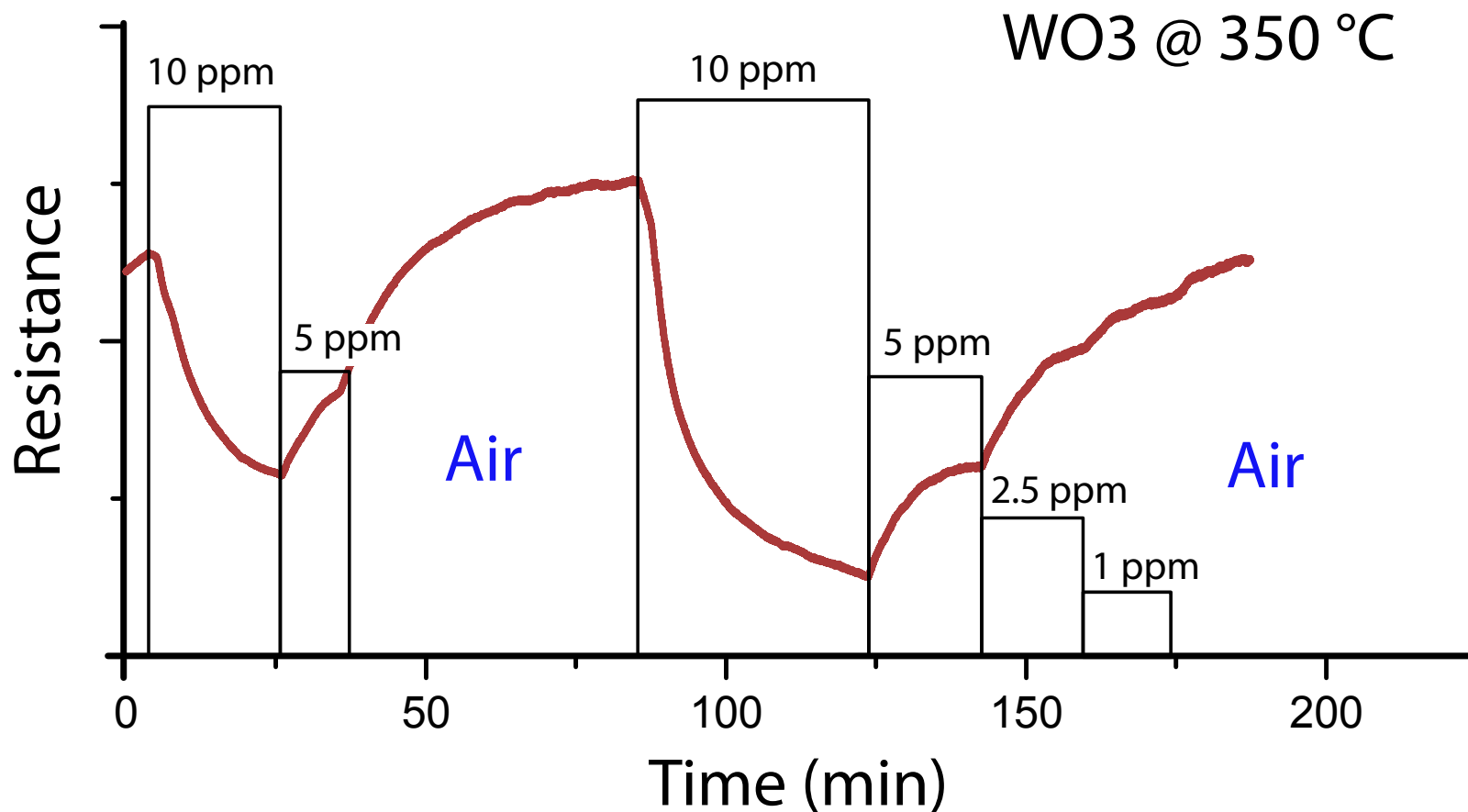
Sensitivity Measurements
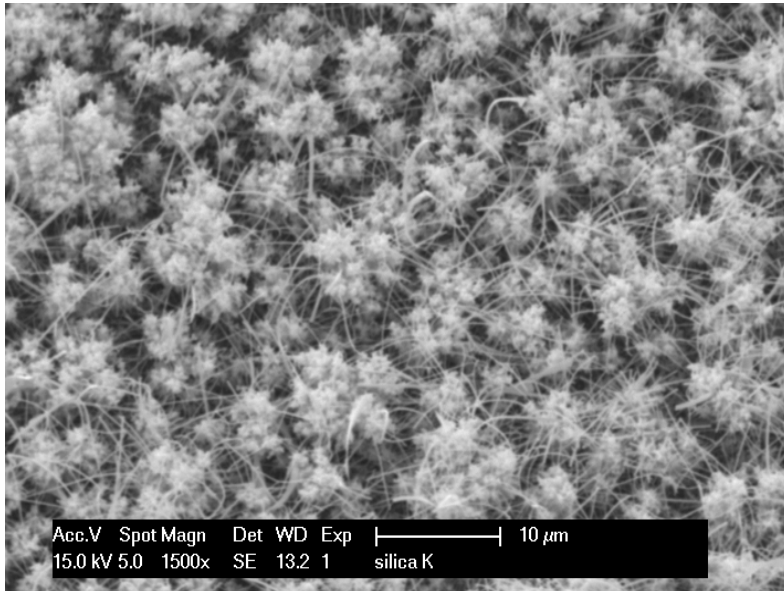
Sensitivity Measurements

Preliminary Tests

WO3 @ 350 °C

Summary

- Aerosol Techniques for Synthesizing Nanostructures Materials for Gas Sensors
  - Nanoparticle Generation
  - Nanomaterial Assembly
- H_2 Sensor
  - Synthesis of Pd Nanostrucutres
  - Sintering by Annealing
- NO_x Sensor
  - Synthesis of WO_3 Nanostrucutres
  - Decorate with Nanowires for Enhanced Performance…

UNIVERSITY
OF THE AEGEAN

TUDelft

The Catch and Outlook

- Catch
  - Analyte in high purity Ar, N$_2$, or synthetic Air
  - If we use ambient air, the story changes completely

- Further work
  - Selectivity
  - Repeatability (long term)
  - Sensitivity (?)