



European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

**WGs and MC Meeting at Cambridge, 18-20 December 2013**

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 2: 1 July 2013 - 30 June 2014 (*Ongoing Action*)

**UV Sensor by Inkjet Printing Technology**



**Dr. Vassileios Binas**

Function in the Action (WG Member,  
Sub-WG Leader, SIG or WG Leader, Chair)

**Post doc researcher / Greece**





***COST Action: TD1105***

***STSM title: n- and p- type sensing metal oxides***

***Dr. Vassilios Binas***

Post Doc Researcher, Chemist

Transparent Conductive Materials Group (Head of the group, prof G. Kiriakidis),  
Institute for Electronic Structure & Laser, Foundation for Research and Technology, Hellas

**Location: Jozef Stefan Institute, Electronic Ceramics Department, Ljubljana, Slovenia**

**Host:** Pr Barbara Malic

Jozef Stefan Institute, Electronic Ceramics  
Department [Barbara.malic@ijs.si](mailto:Barbara.malic@ijs.si)



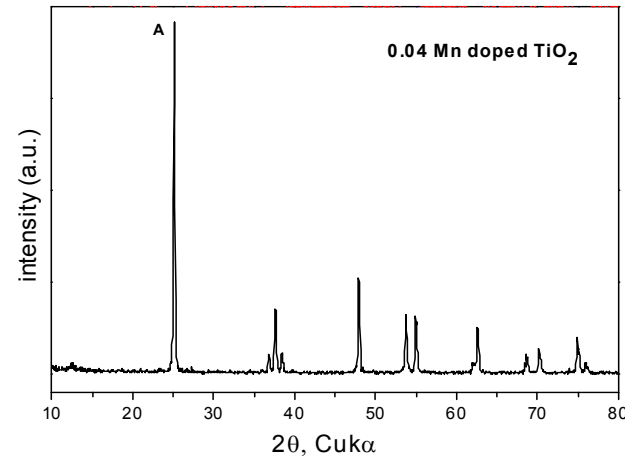
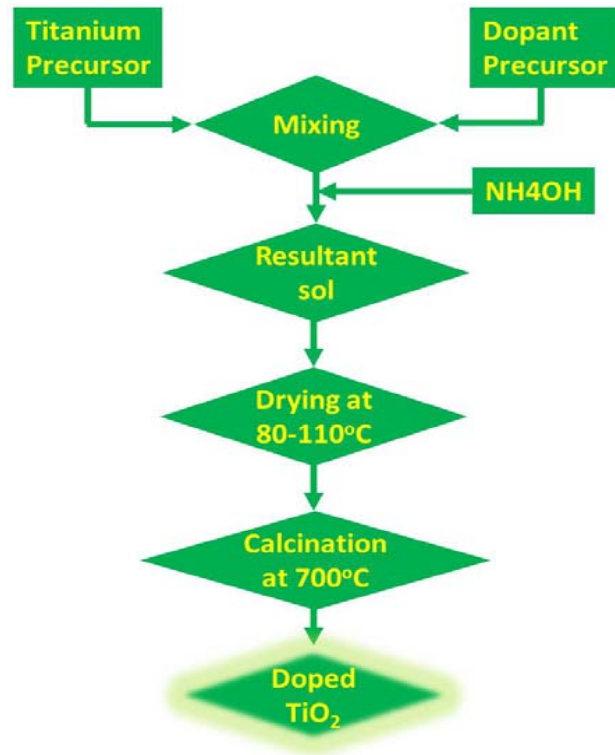
The **emphasis** is *on the functional metal oxides deposited by ink-jet printing* mainly, for *advanced gas sensors applications*.

For this scope, we will be working on:

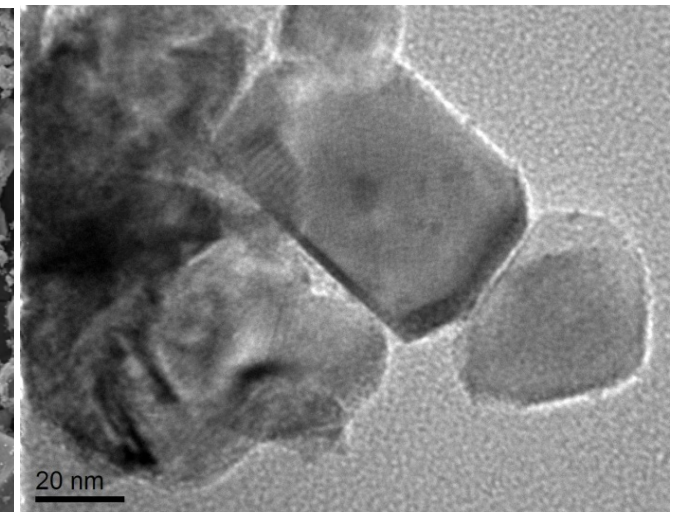
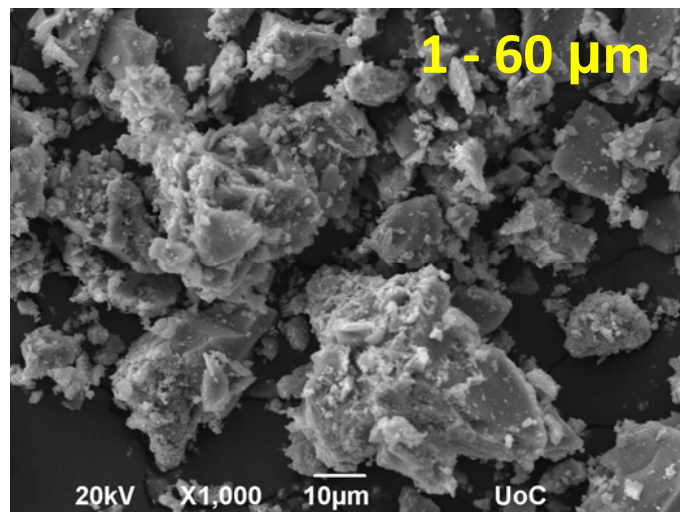
- Solid state synthesis and mechano-chemical synthesis, milling and calcination
- Characterization of powders: particle size and size distribution, phase composition, morphology.
- Preparation and characterization of particle dispersions or solutions of liquid precursors of ceramic materials
- Formulation of inks for ink-jet printing

**\* FORTH study the sensing properties of this thick films**

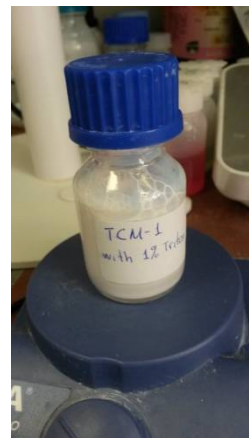
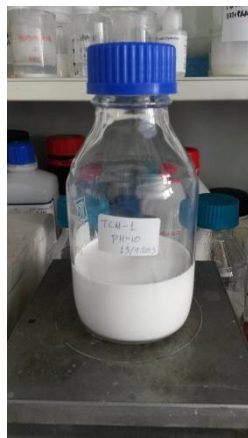
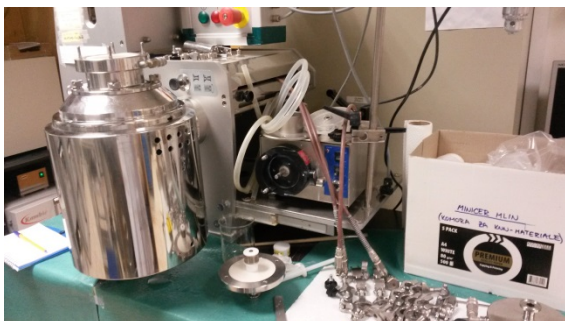
# Characteristics of TCM-1 (Mn doped TiO<sub>2</sub>), in powder form



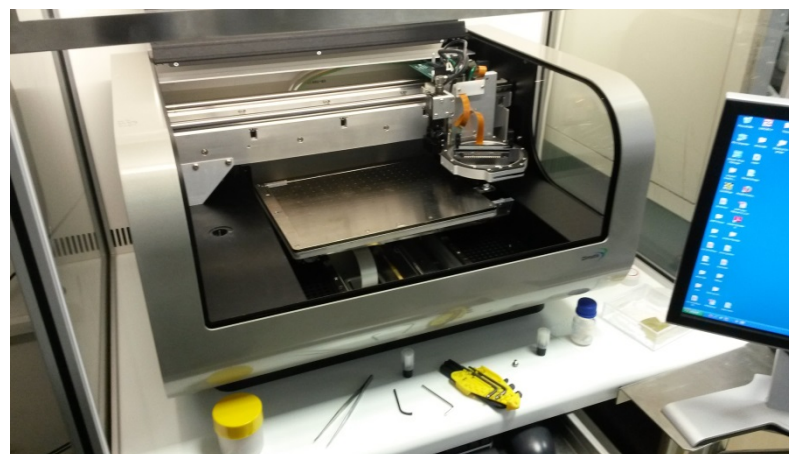
Anatase phase,  
Grain size: 30 -50 nm



## Ink formulation



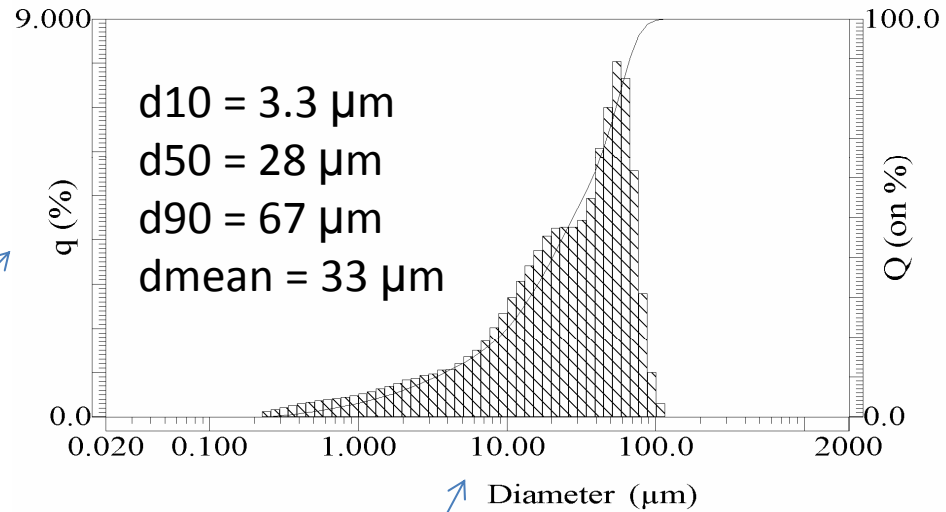
- Viscosity: 10 – 12 mPa s<sup>-1</sup>
- Surface tension: 28 – 33 mN/m
- Particle size: < 500 nm



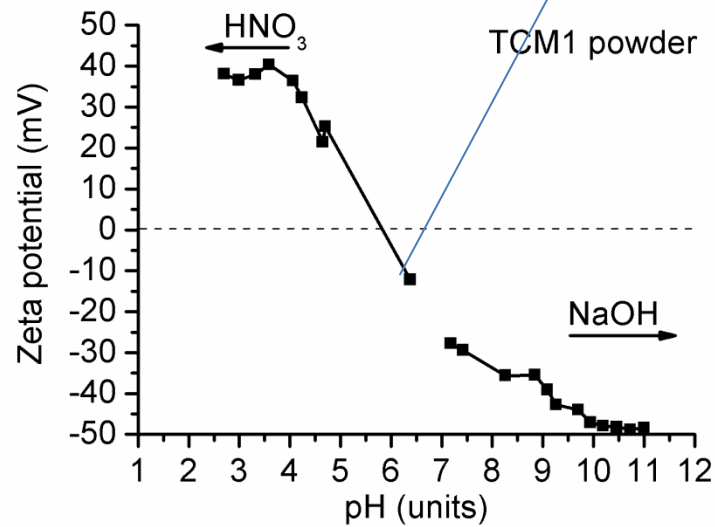


TCM-1 Without mortar  
10ml H<sub>2</sub>O + TCM-1, pH ~ 5.8

TCM-1 With mortar  
10ml H<sub>2</sub>O + TCM-1, pH ~ 5.7



The zeta potential of TCM-1 powder in Water as a function of pH Background electrolyte 0.001M KNO<sub>3</sub>



## TCM-1 Ball Milling

95gr + 100ml of isopropanol

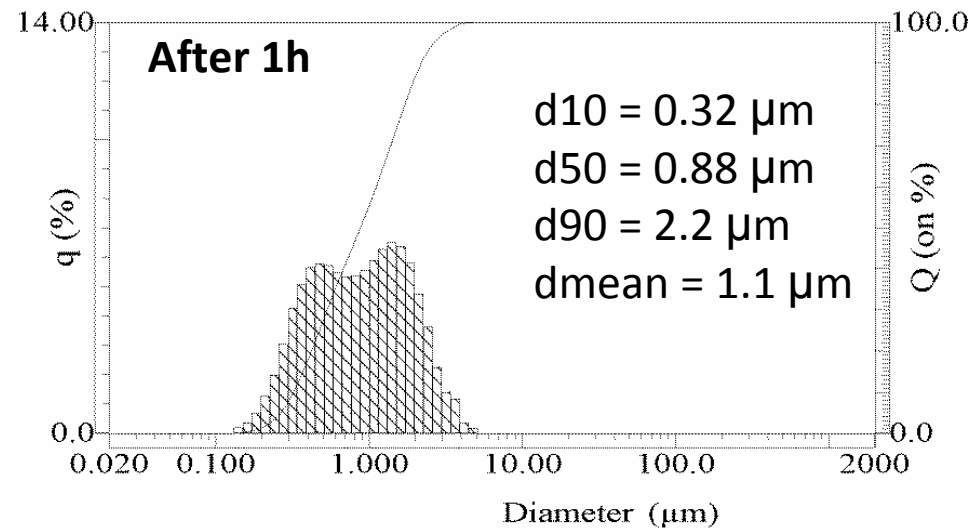
Diameter of balls: 3mm (1kg of YSZ)

Volume: 500ml

Milling parameters: 1h / 200rpm

Drying after milling at 95°C for 3h

TCM-1 after ball milling 86gr



# TCM-1-Suspension

INK-2 Fluid properties

TCM-1 + 1% Triton X100 + 20 vol% glycerol

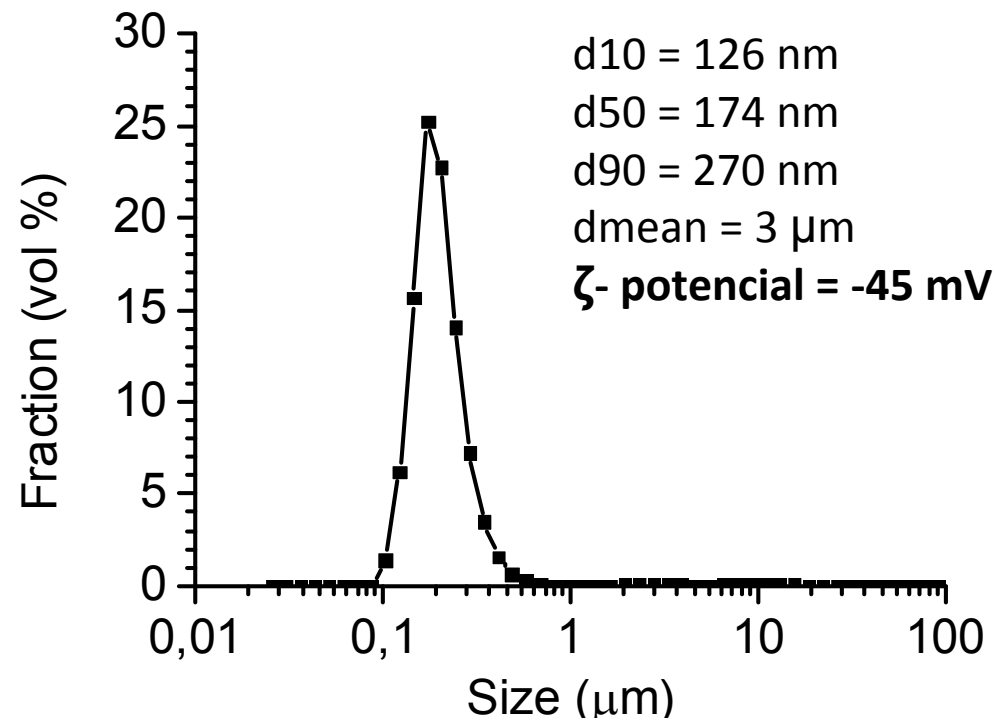
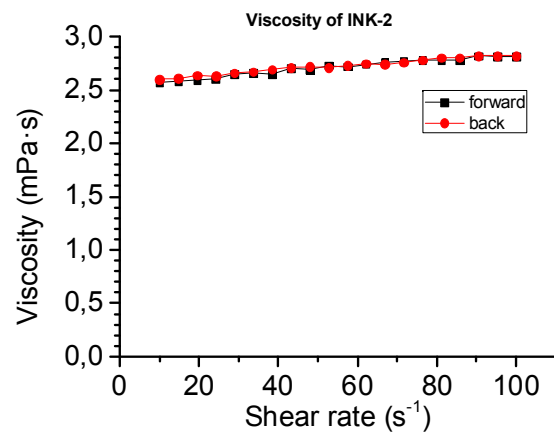
pH ~ 10

Density: 1.2g/ml

Solid Load: 5.3 vol %

Viscosity at  $100 \text{ s}^{-1}$ :  $2.82 \text{ mPa}\cdot\text{s}$

Surface tension  $30.4 \text{ mN/m}$



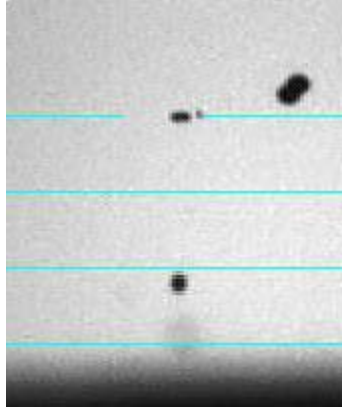
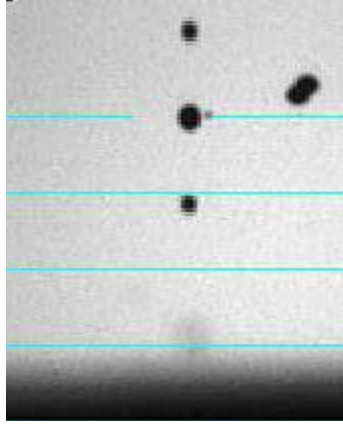
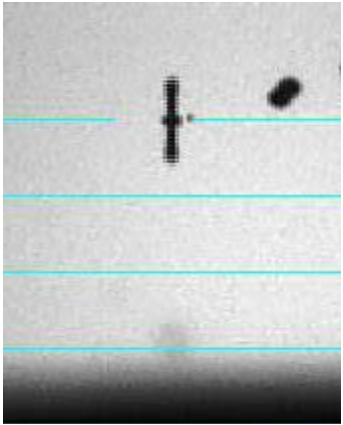
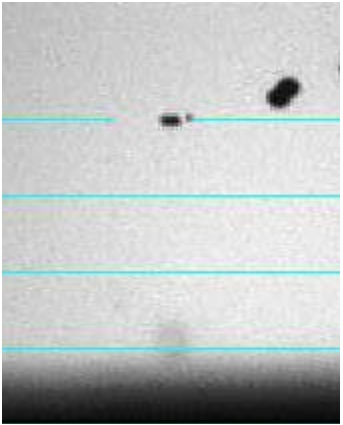




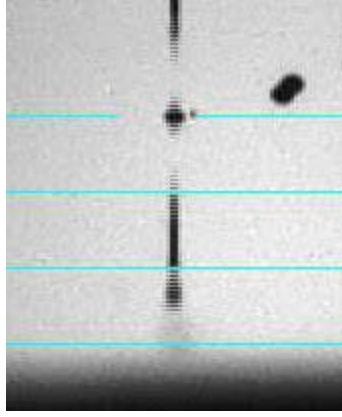
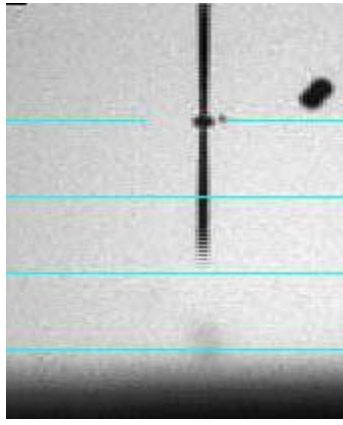
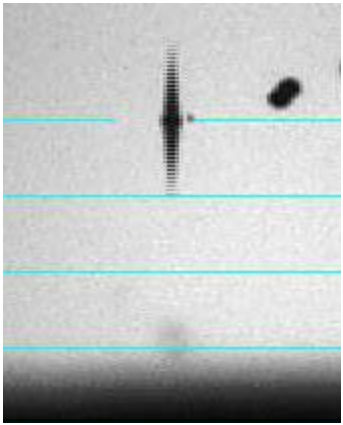
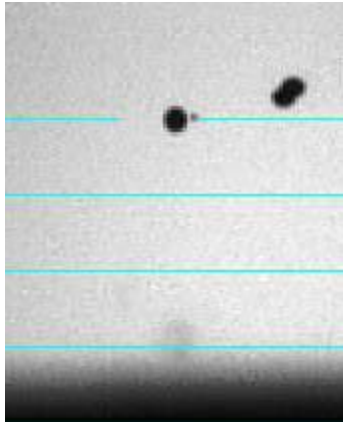
TCM-1-Suspension  
INK-2 Fluid properties

TCM-1 + 1% Triton X100 + 20 vol% glycerol  
pH ~ 10

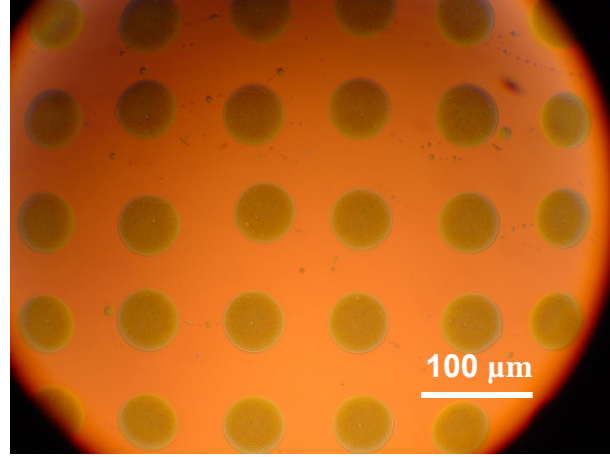
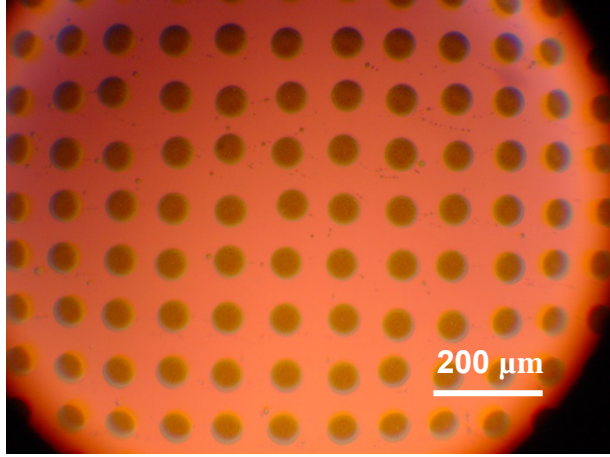
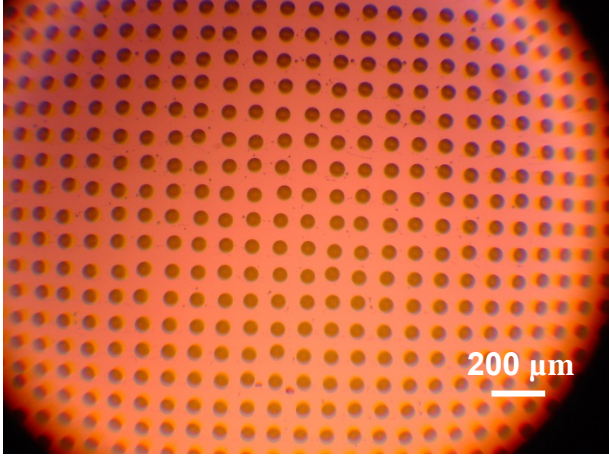
Substrates  
SiO<sub>2</sub>/Si



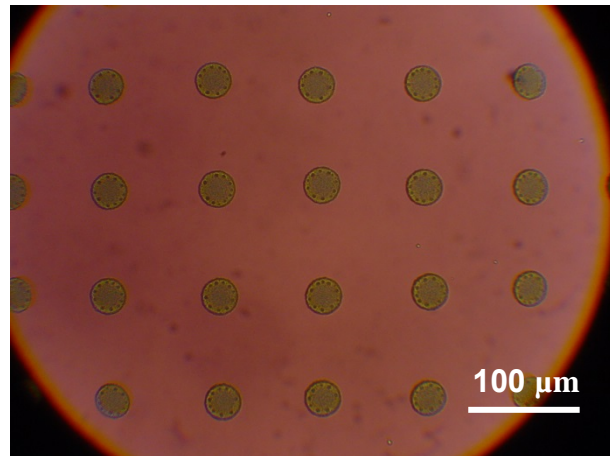
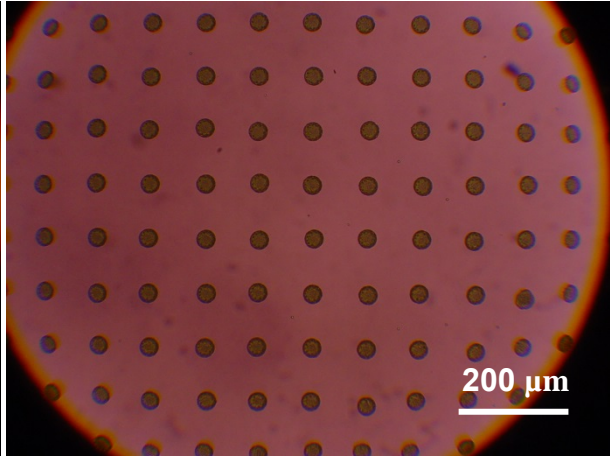
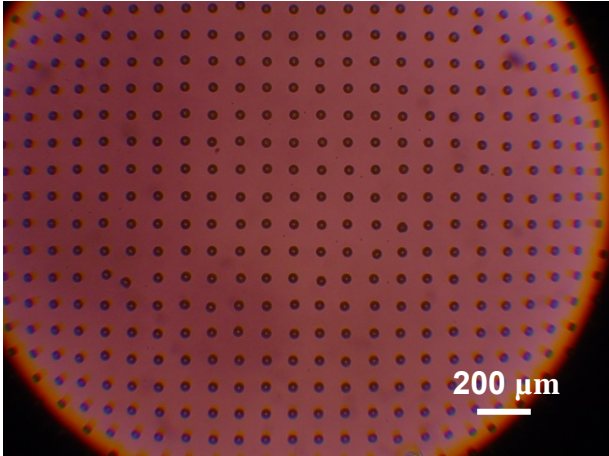
9 volt



15 volt



**before**



**After  
4000C**

