

# NATIOMEM



Treatment Concept Based on Visible Light Photocatalytic Membranes



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2nd Dissemination Workshop of the Nano4water Cluster  
24-25, April 2012  
Aegean Melathron Hotel, Chalkidiki, Thessaloniki, Greece

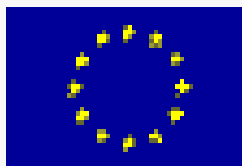


# NATIOMEM

Nano-structured TiON\* Photo-Catalytic  
Membranes for Water Treatment

\*Nitrogen-doped titanium dioxide

July 1<sup>st</sup>, 2010 - June 30<sup>th</sup>, 2013 (36 months)

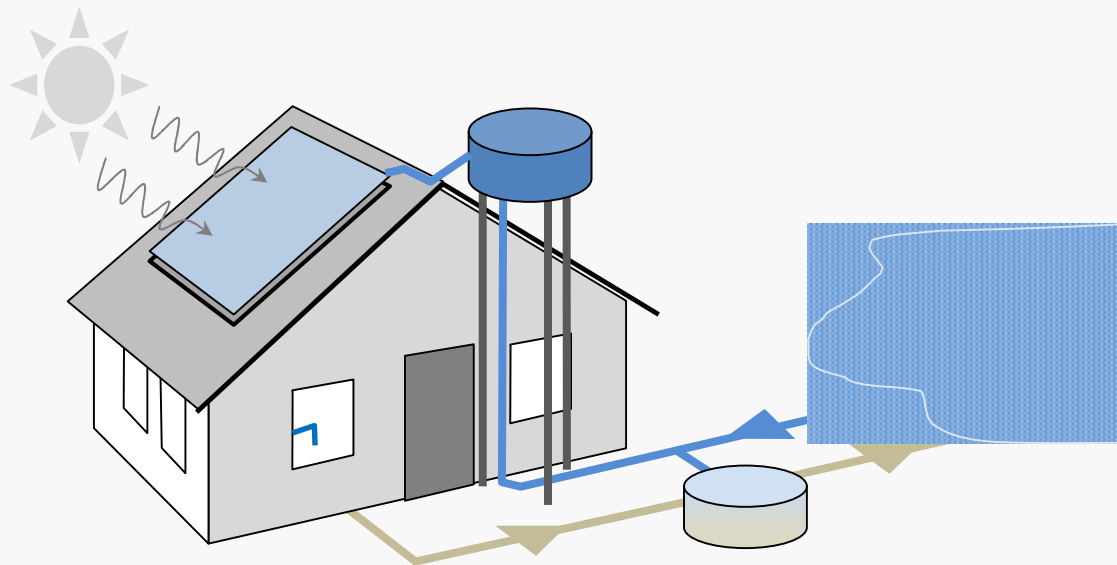


## Concept



Development of high-tech, knowledge-embedded materials and membrane engineering, to produce a simple, low-cost user-friendly water treatment system, which will produce drinking water without using chemicals or energy other than solar irradiation.

Photocatalytic membranes:  
Filtration and inactivation in one process



DHI, Denmark

University of L'Aquila, Italy

Tel Aviv University (TAU),  
Israel

University of Surrey, Great  
Britain

University Pierre & Marie Curie  
(UPMC), France

Skjølstrup and Grønberg ApS,  
Denmark

Umgeni Water, South Africa

Kawar Energy, Jordan

# Two parallel working groups

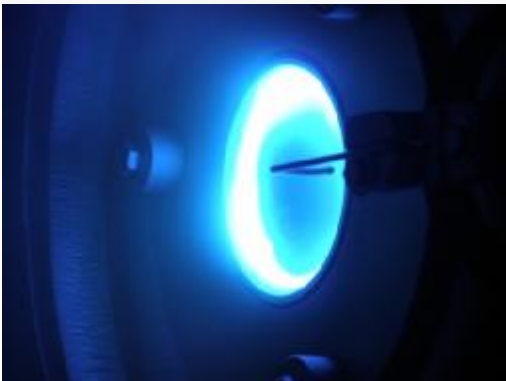


Coating group	Water treatment group
Processes for depositing photocatalytic TiON* films	General design of treatment unit, based on treatment and user requirements
Characterization of photocatalytic activity	Determination of coated substrates filtration characteristics

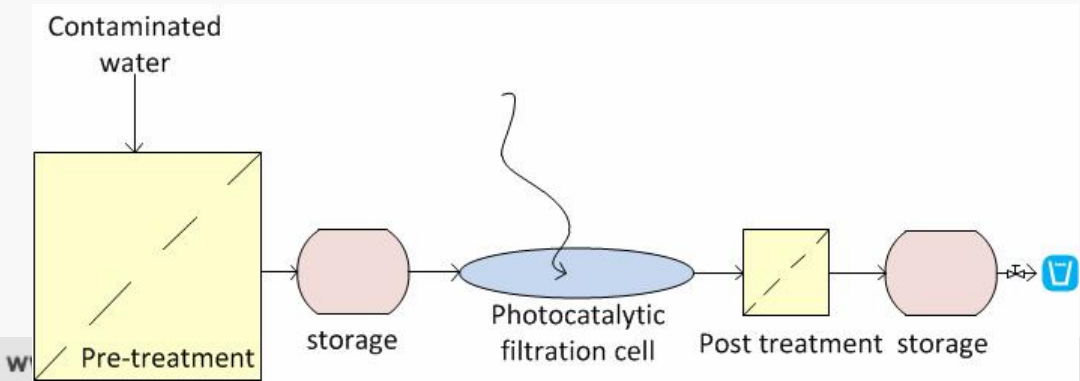


Pilot water treatment plant based upon the optimized photocatalytic materials

*Vacuum arc (TAU)*



*Generic design: unit processes (DHI)*



# Coatings and their characterisation



Robust membrane substrates (MF range)



# Coatings and their characterisation

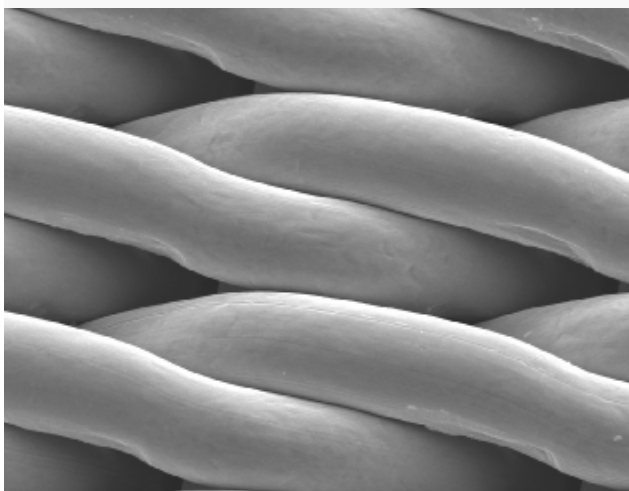


## Sputter deposition & Sol-gel coatings

- Screening at coating partners (MB)
- Characterisation (composition and lab testing)



**Example of sputter deposited coatings**



**SEM of woven metal membrane**

10/19/2011 HV Spot Mag Det HPW WD —20.0um—  
4:37:07 PM 30.0 kV 3.0 1100x ETD 0.12 mm 6.2 mm University of Surrey

# Lab-testing of coated membranes



I

Photocatalytic properties:  
Comparison of coatings by photocatalytic degradation of specific chemical substances. One method, many coated membranes

II

Robustness and disinfection: Backwashing, cleaning, microbial barrier.  
Several test methods, few coated membranes

III

Mechanistic investigations:  
Filtration mode and circulation flows, cover glass, salinity, fouling.  
Specific tests using one promising membrane

DI water, 1 mg/l Carbamazepine (CBZ)

# Lab-testing of coated membranes



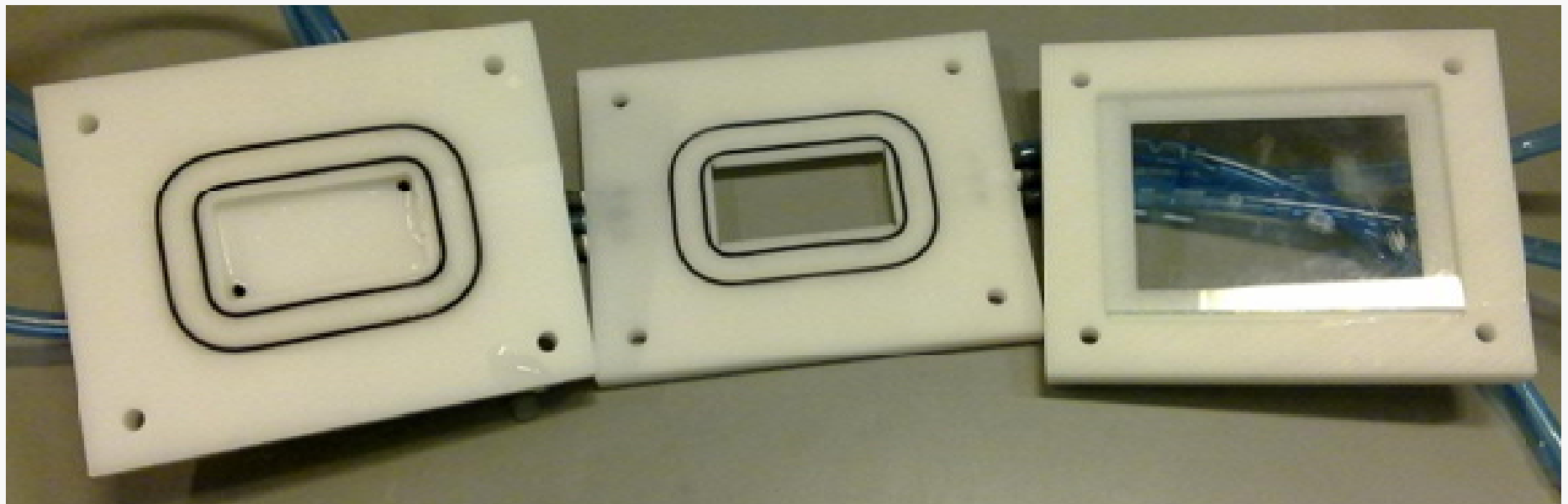
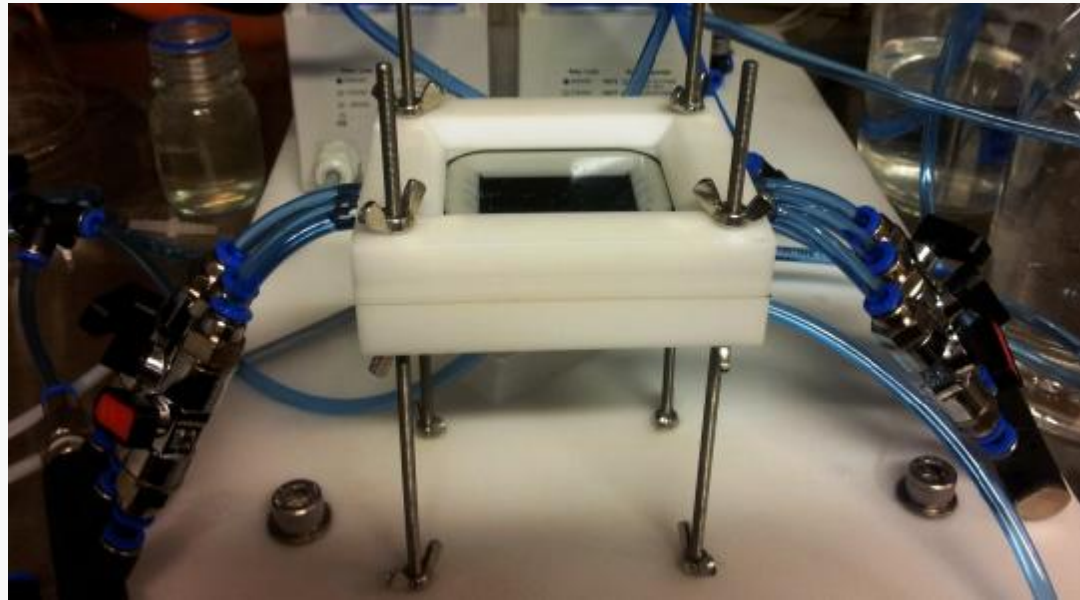
1. Membrane size suitable for all coating methods
2. Dead-end and cross flow filtration mode,
3. Recirculation of permeate over the substrate surface,
4. Feed water able to enter from non-coated or coated side of membrane,
5. Membranes very thin and up to 1 cm thick,
6. Handle membranes without sealed edges,
7. Operate with or without cover,
8. Quartz cover to avoid low wavelength light blockage,
9. Easy to assemble and disassemble.



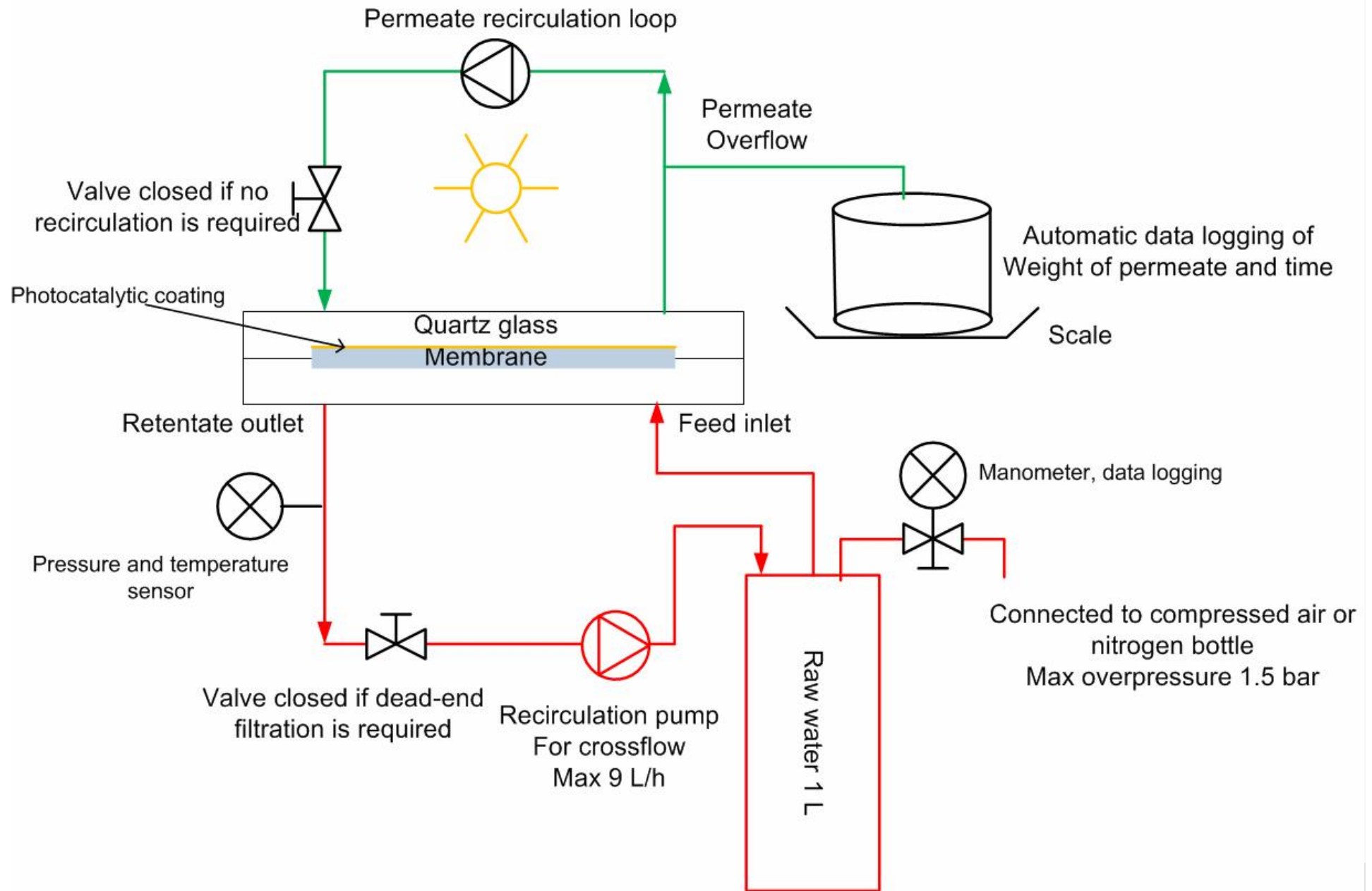
# Lab-testing of coated membranes



Flow cell for  
37 x 55 mm  
coated  
membranes



# Lab-testing of coated membranes



# Lab-testing of coated membranes



In action with solar simulator



# Prerequisites for system design



Application targeted by end-user partners:

- South Africa: *Rural*

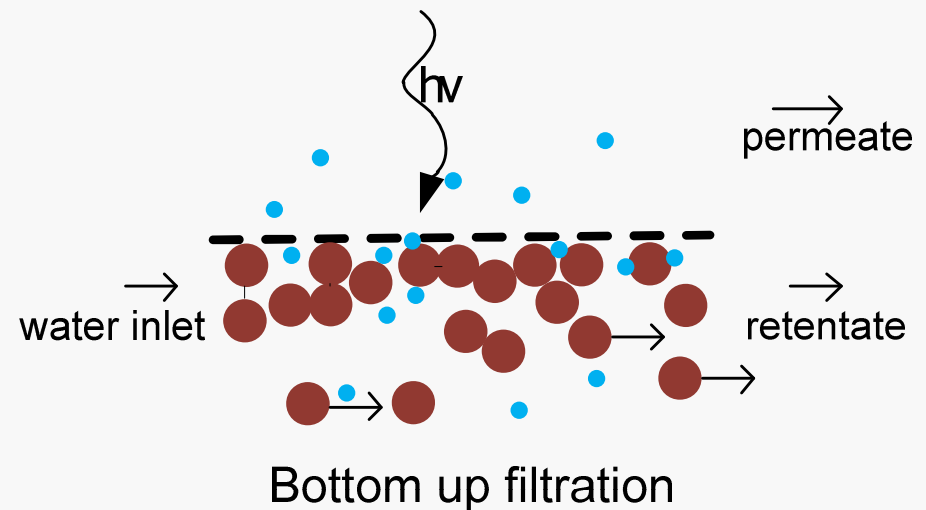
Drinking water from pre-treated contaminated ground and surface water

- Jordan: *Urban*

a) Irrigation and toilet flush water from pre-treated grey water

b) Disinfection of unsafe piped drinking water

Filtration principle: bottom-up



# Design of pilot plants



Pilot plant constructed for Jordan



# Conclusions



In NATIOMEM,

- Coatings with fair to good photocatalytic activity developed (Proof of concept I), available as small samples. Challenging to transfer to membranes, and scale-up.
- Tests with custom-made flow cell on-going: efficiency of coatings to degrade chemical substances, filtration mode, microbial barrier, cover material, interference, fouling.
- Pilot plants designed and produced, to be tested with conventional membranes shortly, in South Africa and Jordan. Most promising photocatalytic membranes from the lab testing applied as they become available in the necessary size.

Thanks for your attention!



Natiomem  
nano 4 water cluster

