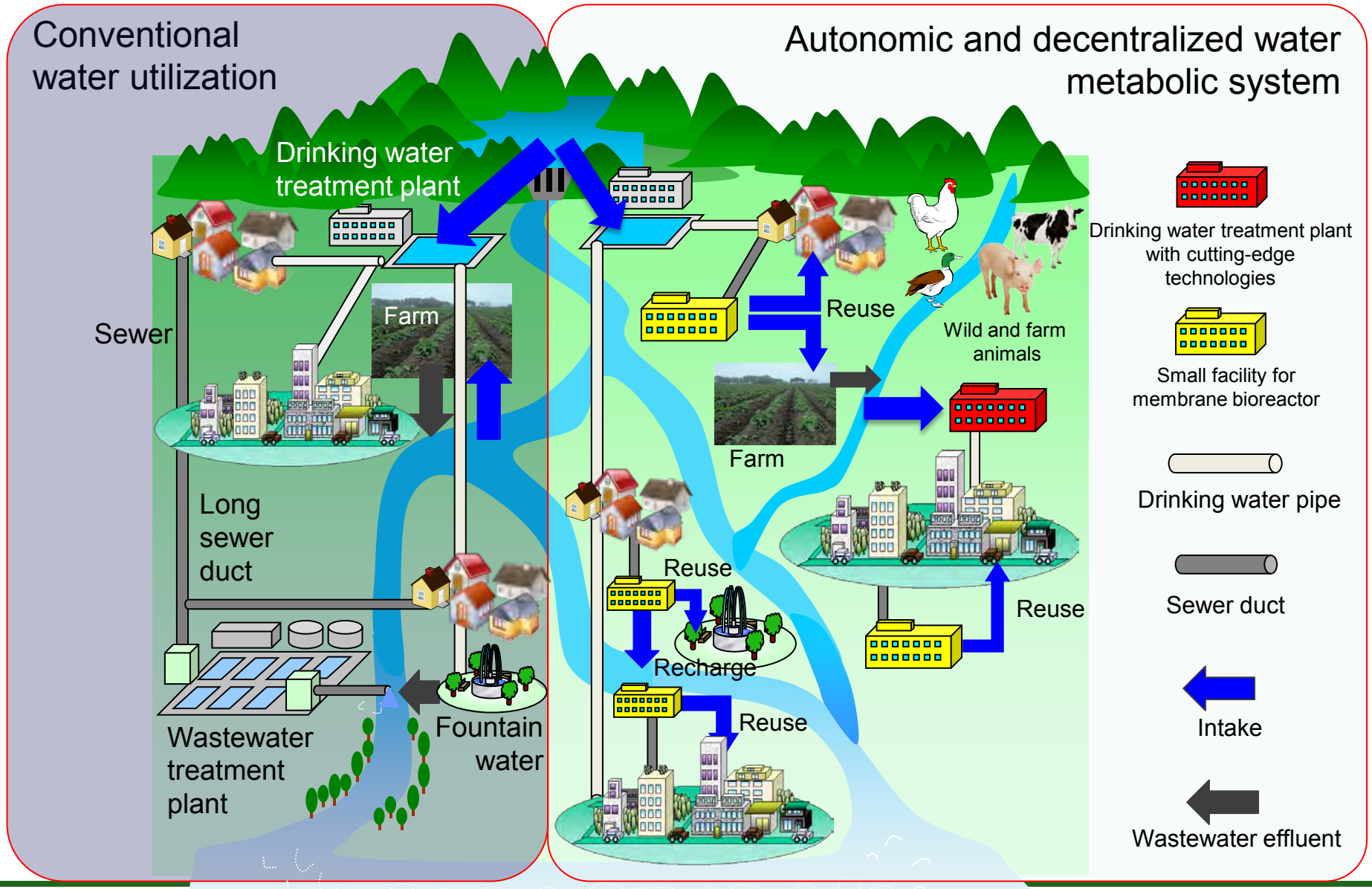
HOKKAIDO UNIVERSITY

# Development of a novel photocatalytic nano-composite membrane to create new water resources from wastewater

**Daisuke Sano, Ph.D.**

**Associate Professor**
**Division of Environmental Engineering**
**Faculty of Engineering**
**Hokkaido University**

Mar. 5th, 2013



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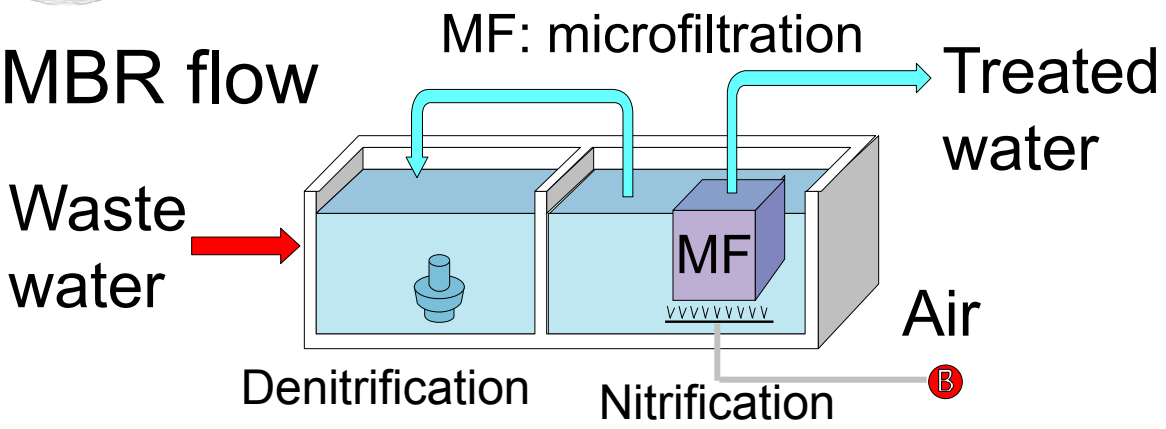
# Membrane Bioreactor (MBR)

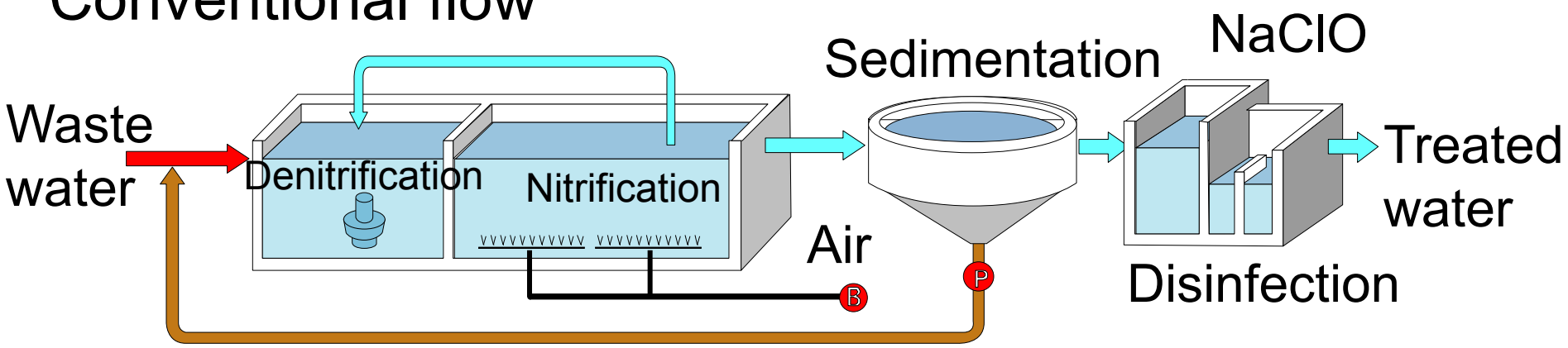
## MBR flow



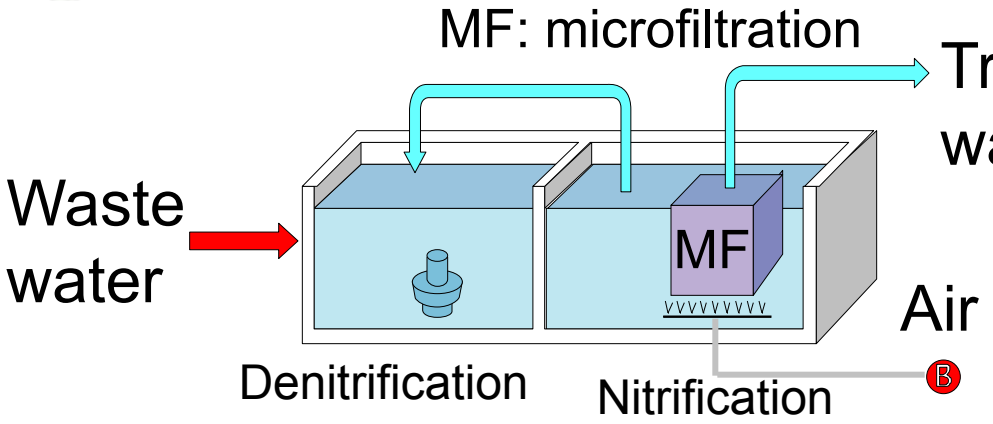

## Advantages

- Small footprint
- Simple operation
- Simple maintenance

## Conventional flow



# What we have to pay attentions to are…



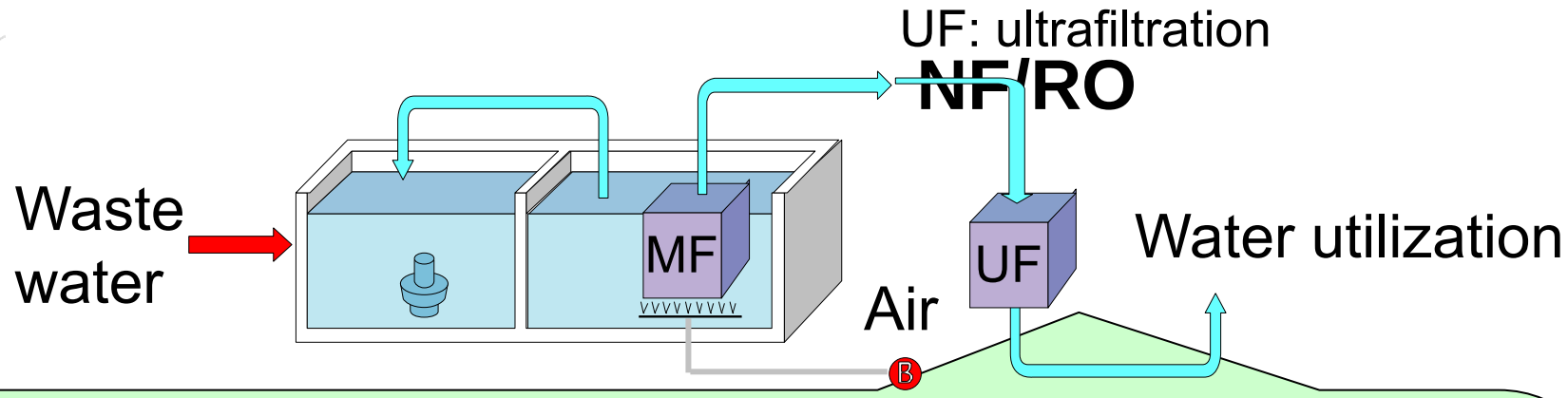

**NF/RO**

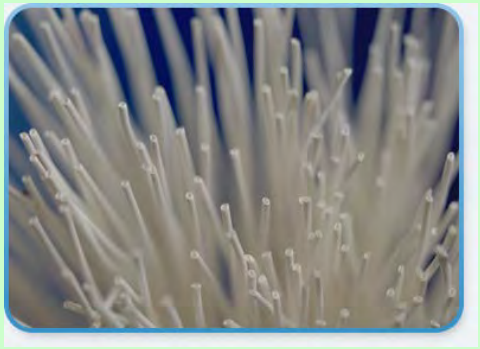
Fouling and brine generation in NF/RO

**- Organic matter in MBR effluent**

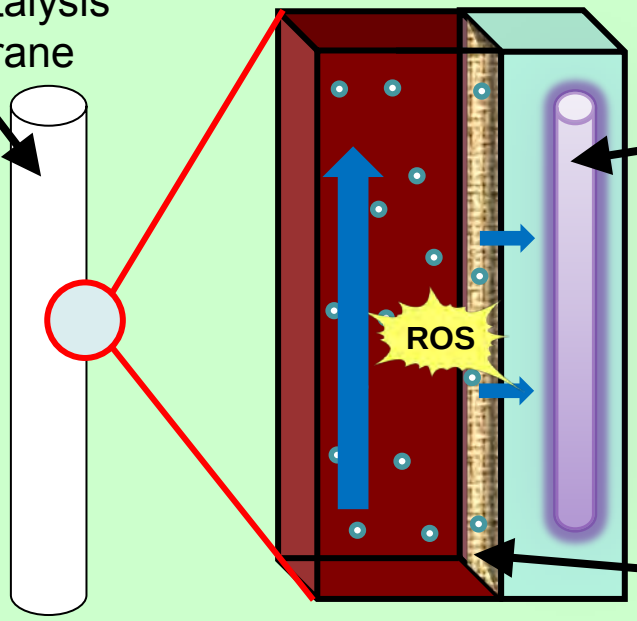
**- Viral pathogens and micropollutants**

# What we would like to achieve…

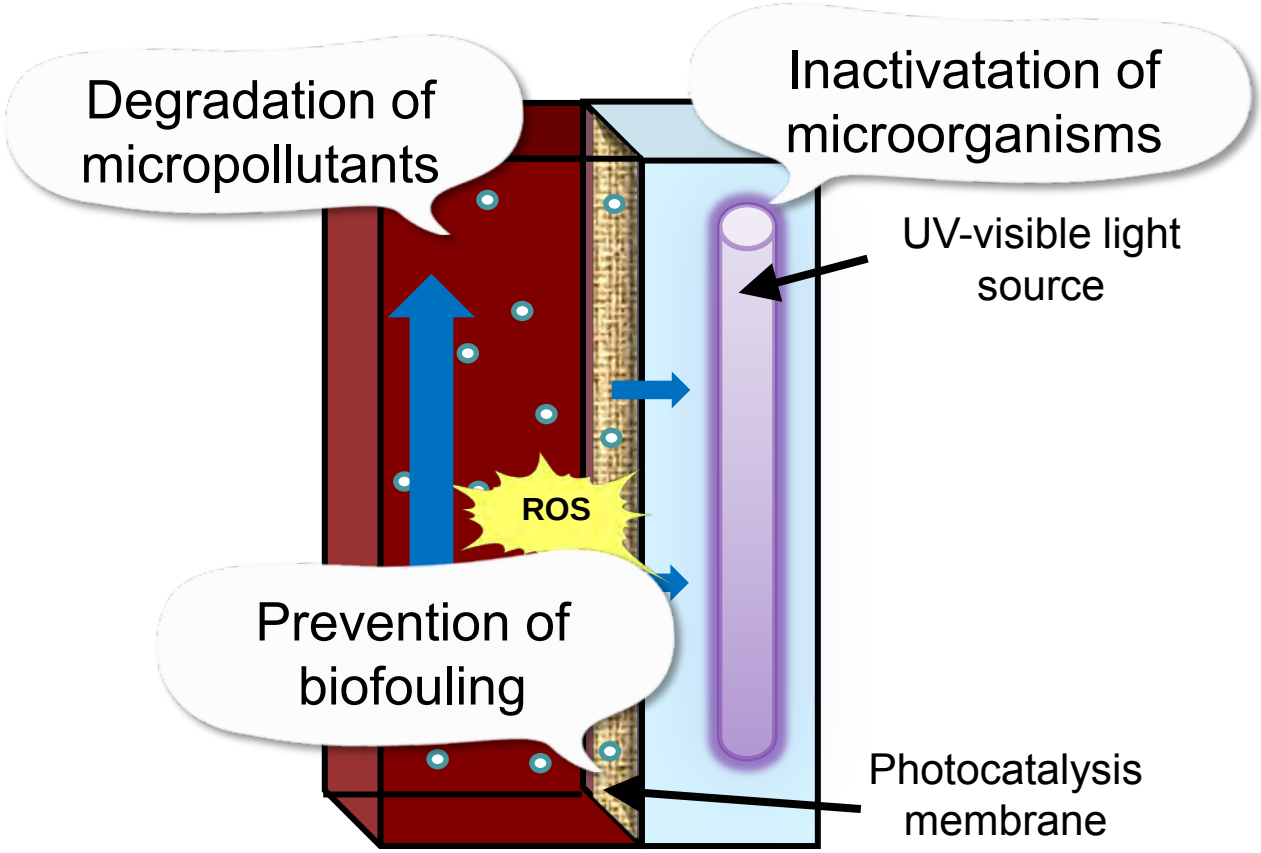


Hollow fiber UF membrane



# What we would like to achieve…



# Main members

JAPAN

Dr. Katsuki KIMURA
Hokkaido University
Water Treatment Engineering
Membrane Technology

Dr. Daisuke SANO
Hokkaido University
Water Treatment Engineering
Public Health Microbiology

Dr. Hisashi SATOH
Hokkaido University
Water Treatment Engineering
Water Chemistry

Dr. Hiroshi YAMAMURA
Chuo University
Water Treatment Engineering
Membrane Technology

**Team Leader**
Prof. Satoshi OKABE
Hokkaido University
Water Treatment Engineering
Environmental Microbiology

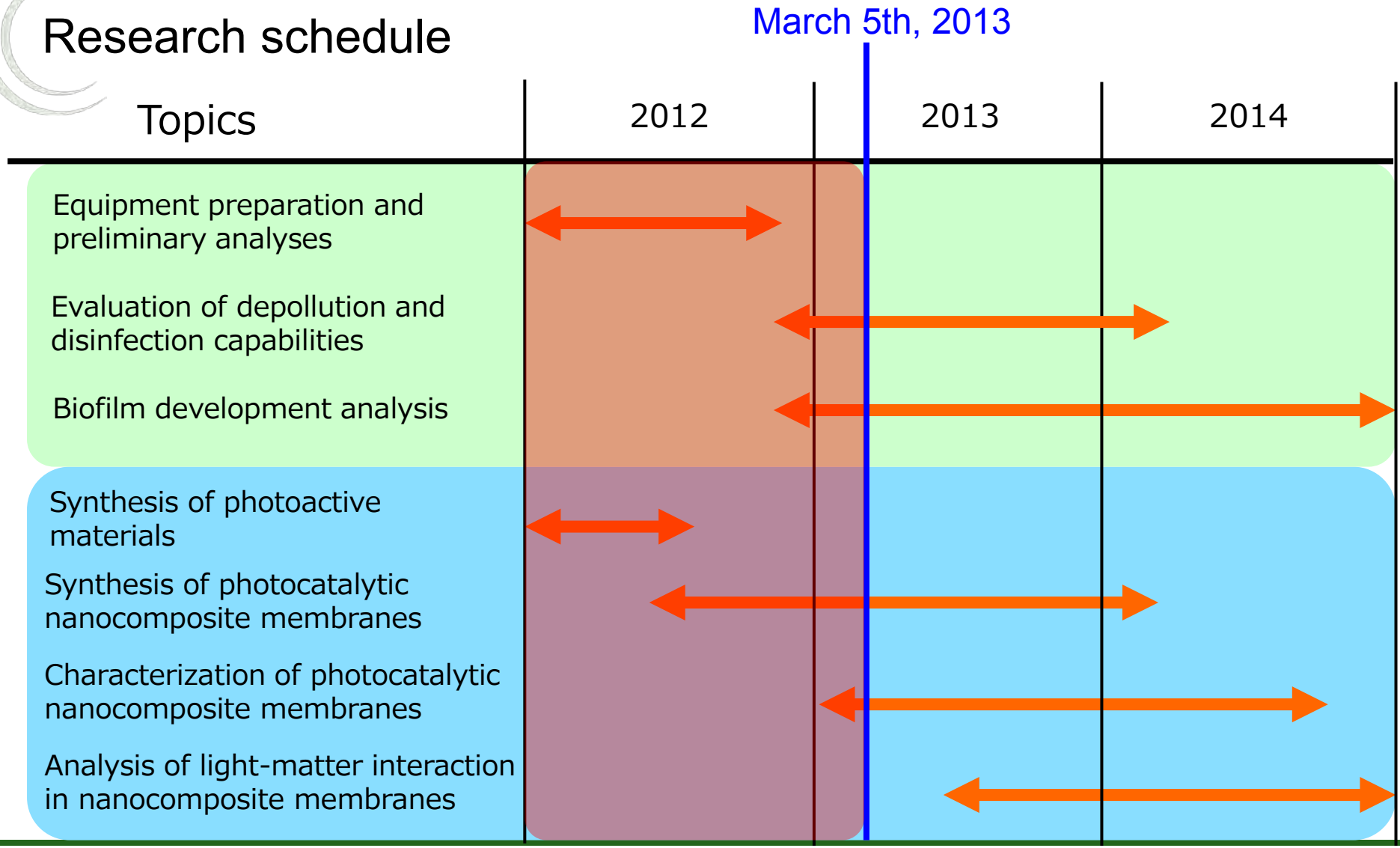
SPAIN

**Team Leader**
Prof. Marcos Fernandez-Garcia
ICP-CSIC

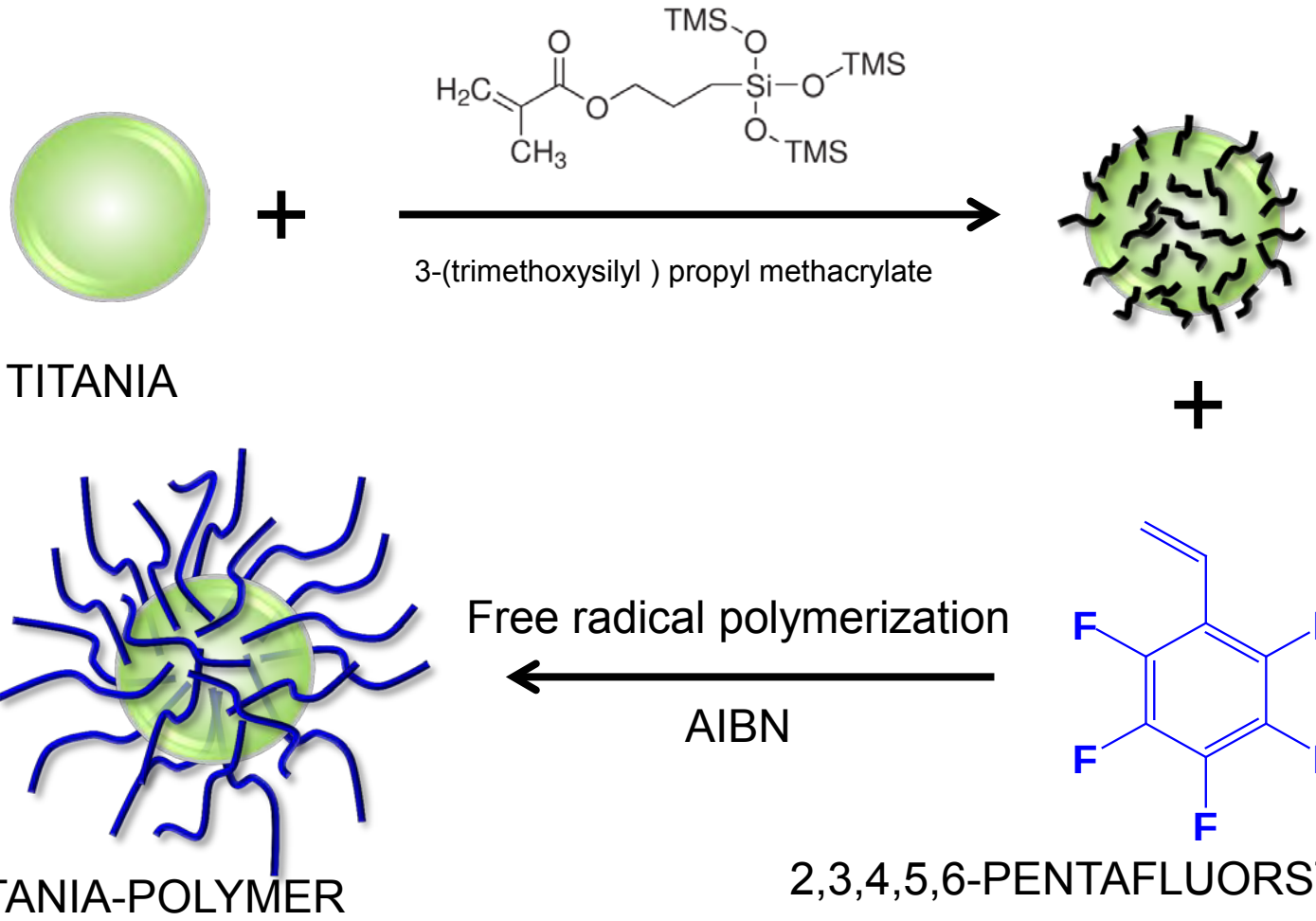
Dr. Maria Luisa Cerrada
(ICP-CSIC)

Dr. Marta Fernandez-Garcia
(ICP-CSIC)

# Research schedule



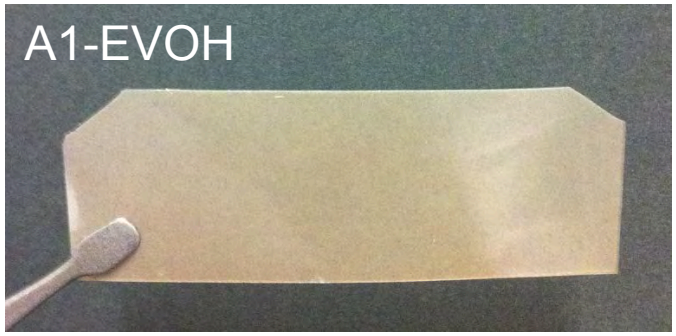
# Modification of titania (Spanish team)

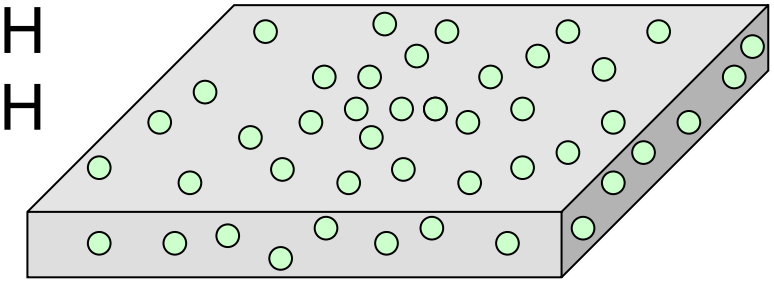


# Synthesis of photoactive materials (Spanish team)

## Ethylene vinylalcohol copolymer (EVOH) films

EVOH
A1-EVOH
A2-EVOH
B2-EVOH
S-EVOH
C1600-EVOH
C1700-EVOH

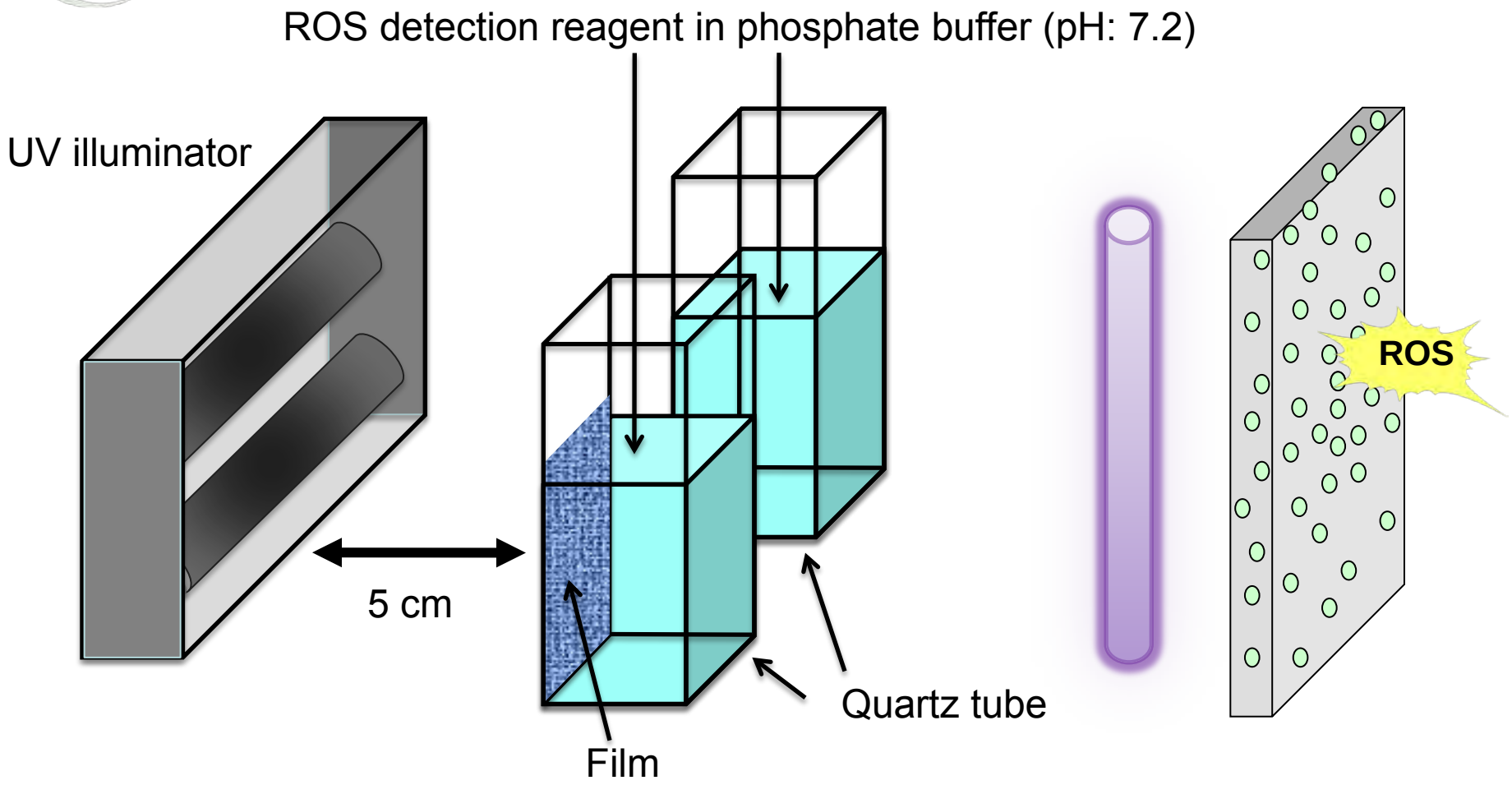


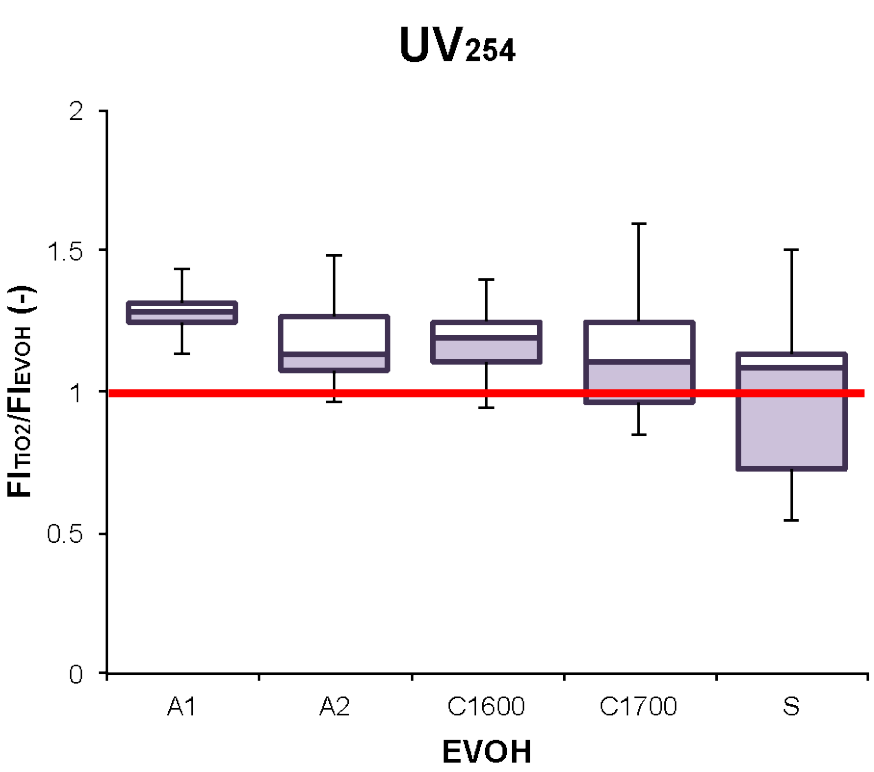
## Polypropylene (PP) films

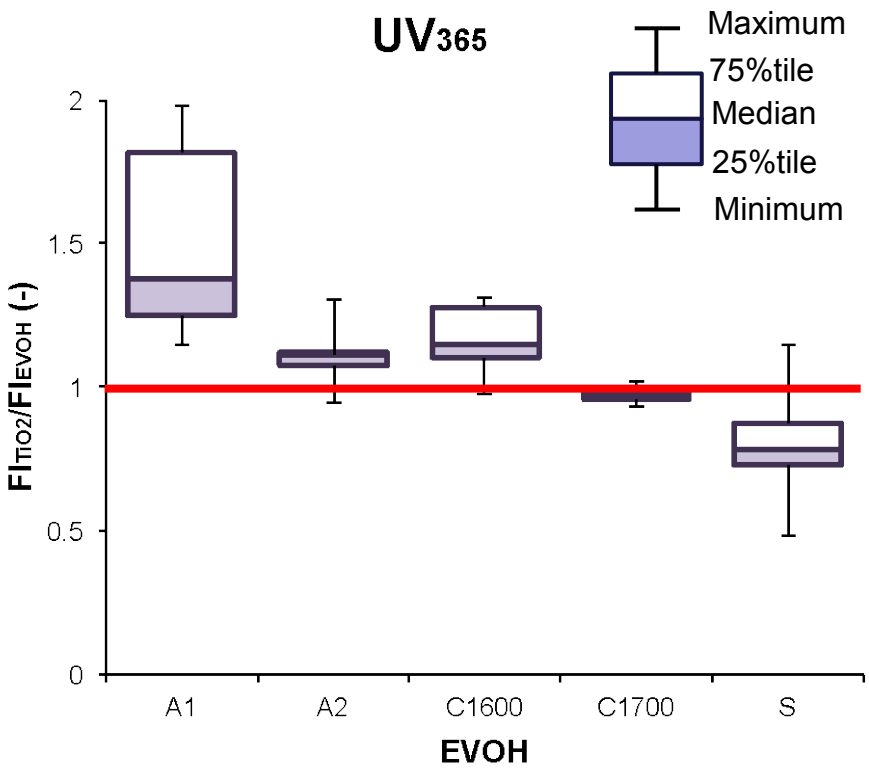
PP
S-PP
A1-PP
A2-PP
B1-PP
B2-PP
C1600-PP
C1700-PP

# ROS production potential of films (Japanese team)



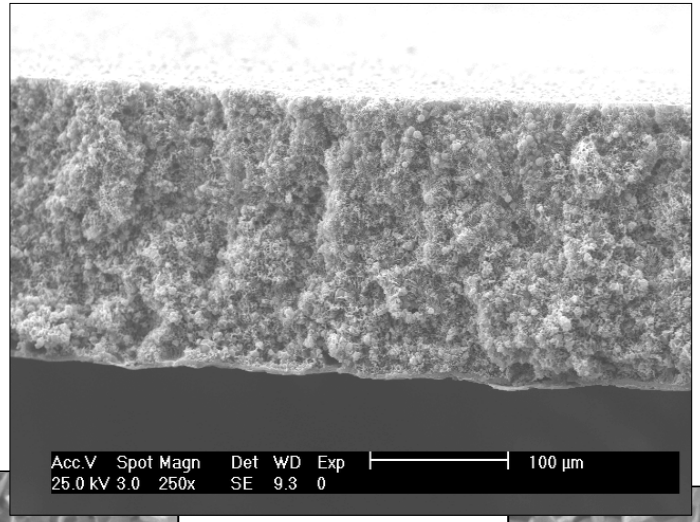
# Total ROS production (Japanese team)



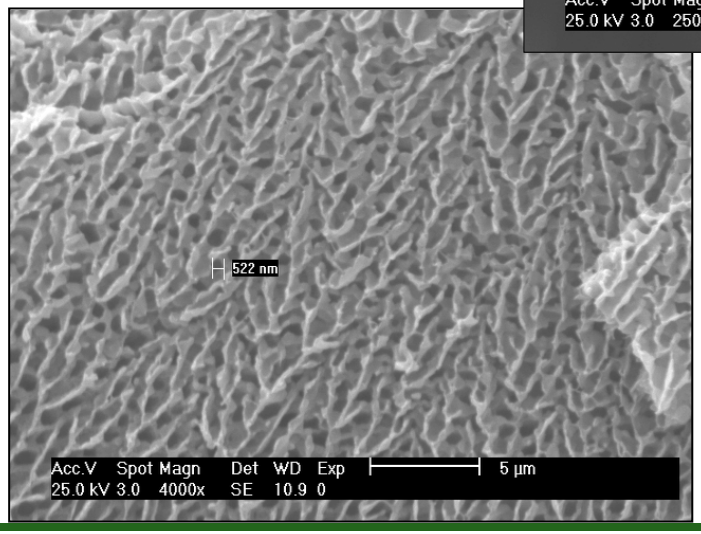
# Preparation of membranes (Spanish team)

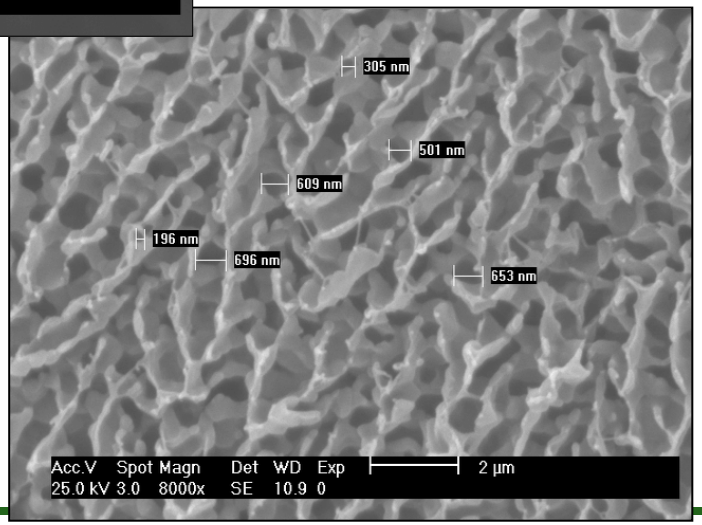
PVDF / Sulfolan




TIPS

ϕ = 150 – 200 µm
Pore size = 200 – 700 nm



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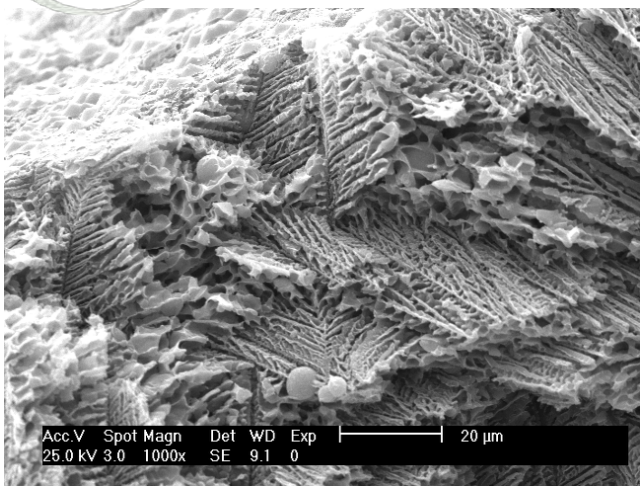
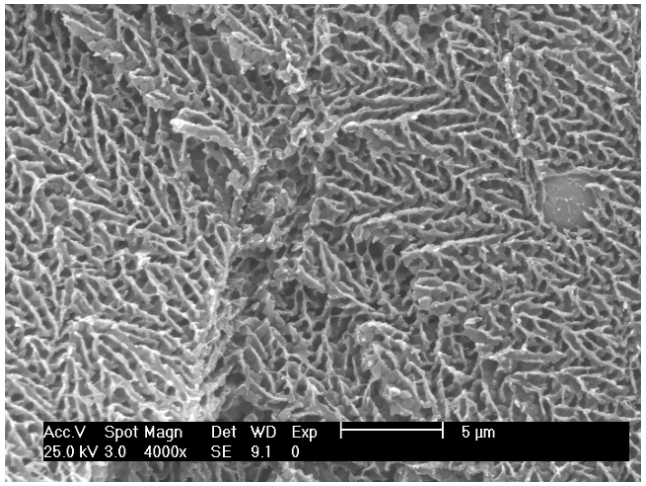
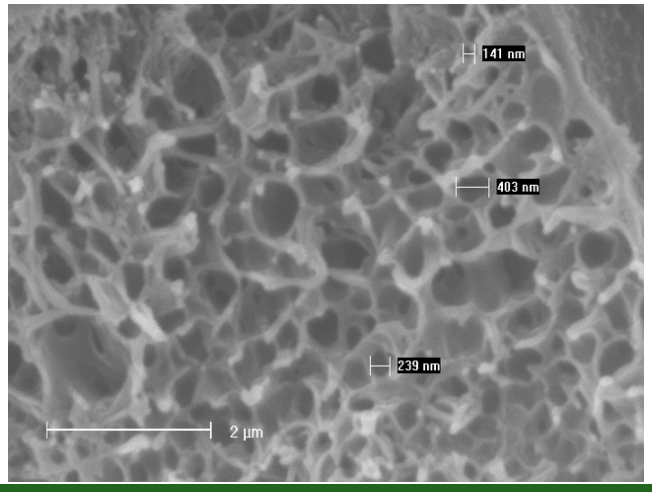
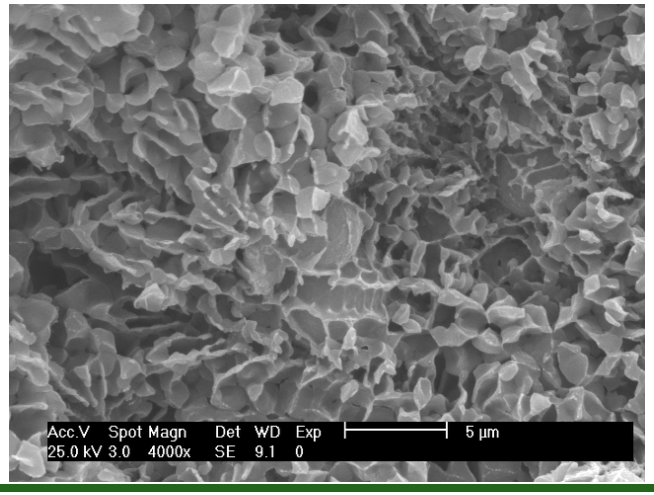
# Preparation of membranes with titania (Spanish team)



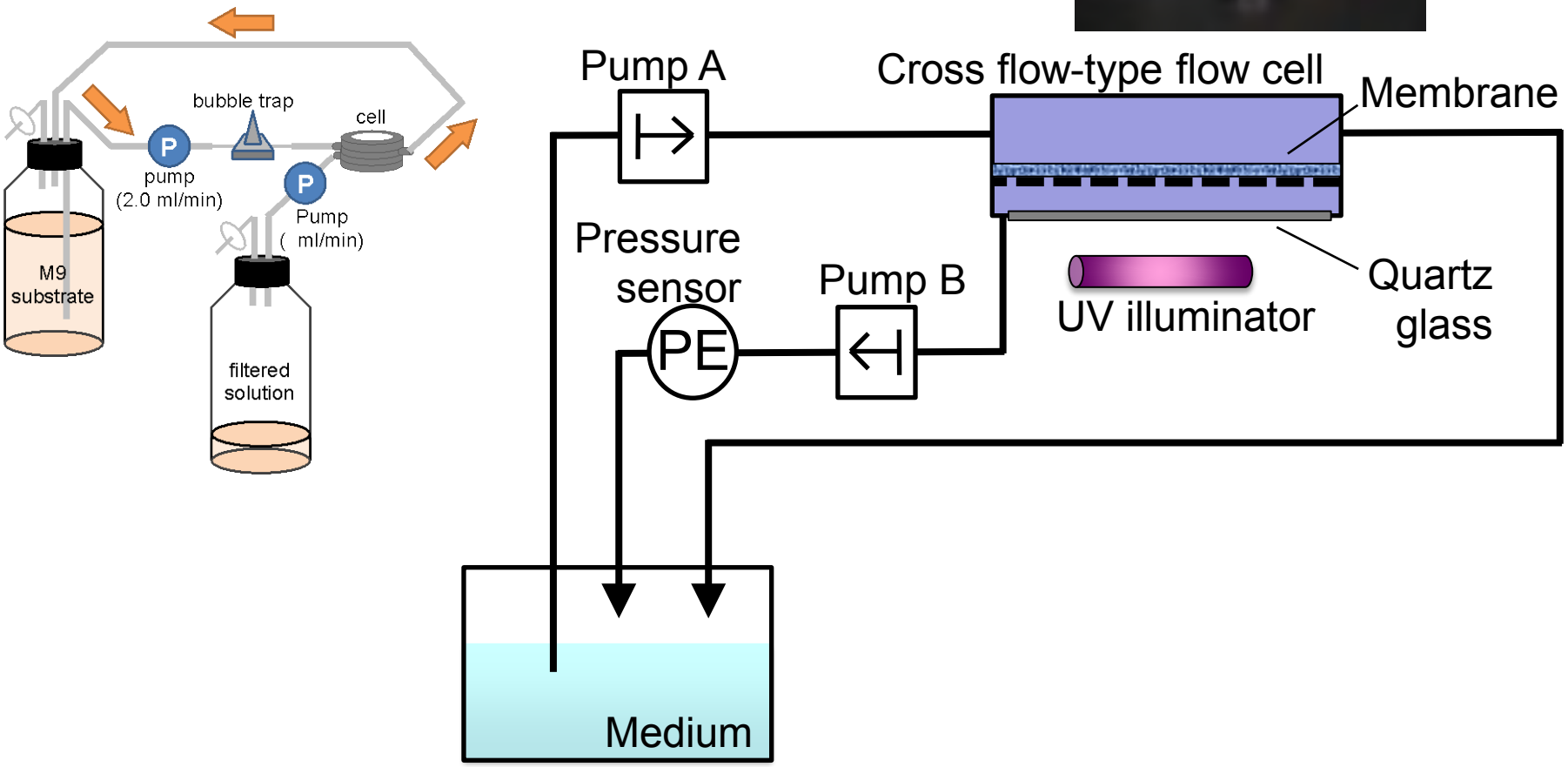




PVDF-$TiO_2$ / Sulfolan

$\phi$ = 350 – 400 µm
Pore size = 150 – 700 nm

# A continuous-flow cell (Japanese team)



# Main members

SPAIN

JAPAN

**Membrane production + titania provision**

**Team Leader**
Prof. Marcos Fernandez-Garcia
ICP-CSIC

**Depollution, disinfection and biofilm prevention capabilities**

**+**

**Membrane production**

Dr. Katsuki KIMURA
Hokkaido University
Water Treatment Engineering
Membrane Technology

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Water Treatment Engineering
Public Health Microbiology

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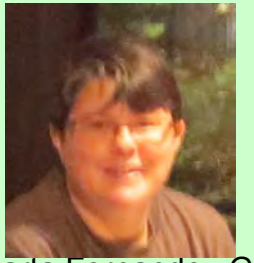
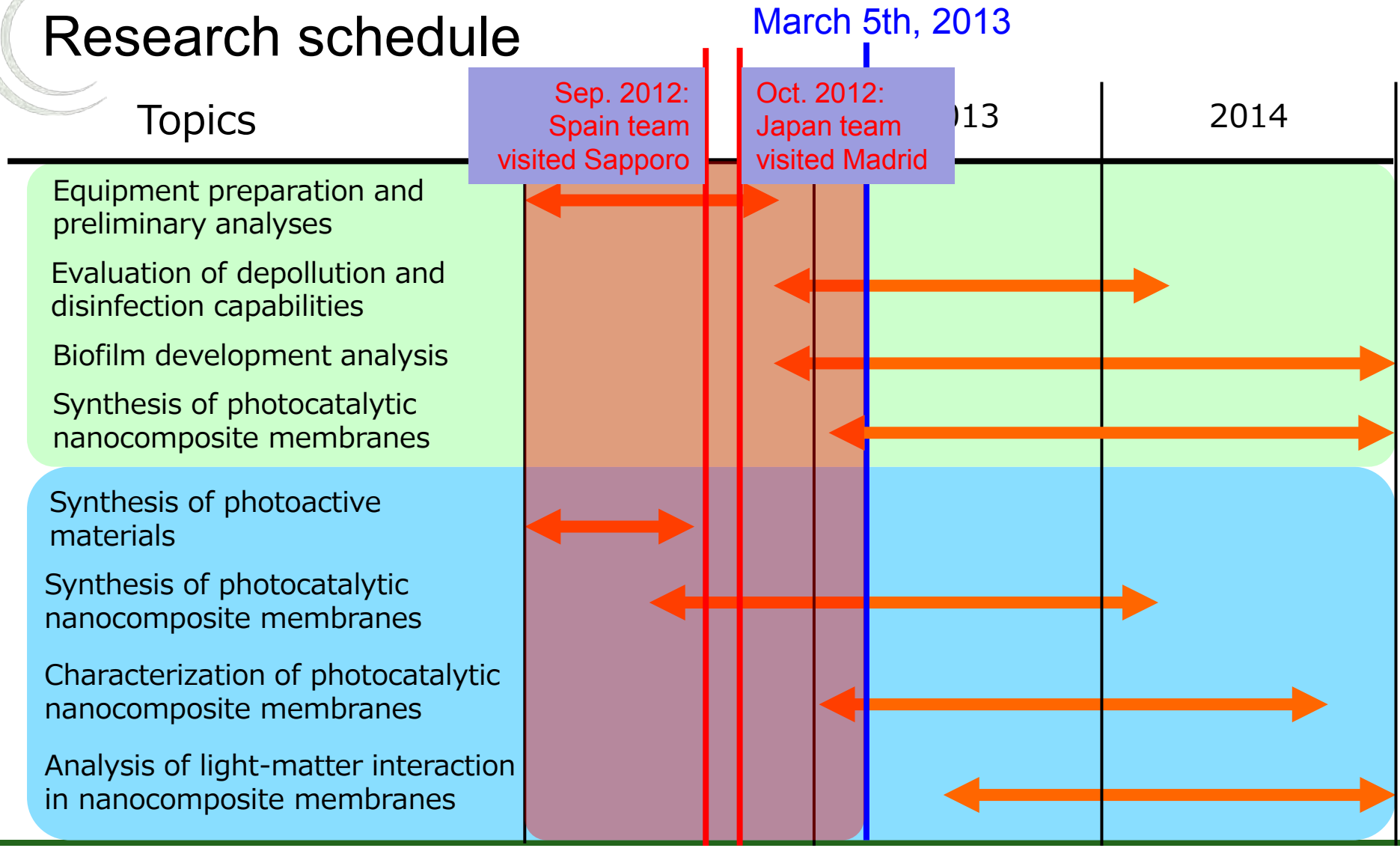


Dr. Marta Fernandez-Garcia
(ICP-CSIC)

# Research schedule



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# Summary and future perspectives

- Photocatalysis capability of prototype films was tested.
- Prototype membranes are being produced by both sides of Japan and Spain teams.
- Flow cell type reactor for analyzing biofilm prevention, chemical decomposition and virucidal capabilities of photocatalytic nano-composite membrane was constructed.
- Biofilm formation, chemical decomposition and virucidal capabilities of photocatalytic nano-composite membrane will be tested using real wastewater.