

The background of the slide features a light blue to purple gradient. It is decorated with numerous water droplets and bubbles of various sizes, some with highlights and shadows, giving a fresh and clean aesthetic.

# **SOLAR-BASED TECHNIQUES FOR WATER PURIFICATION IN AFRICA – NEW TECHNOLOGIES FOR FOOD SECURITY**

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**GFS Food for Thought Coffee Break**

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# Introduction: Key Facts

- Food security occurs when all people can access enough safe and nutritious food to meet their requirements for a healthy life, in ways the planet can sustain into the future.
- Water is key to food security.
- The quality of drinking water affects the effective absorption of nutrients by the human body.
- At the household level, contaminated drinking water can compromise food security

# Introduction: Key Facts

- According to WHO, about 10% of the total burden of disease worldwide could be prevented by improvements in drinking water, sanitation, hygiene and water resource management.
- This makes the global importance of safe drinking water key for development, poverty reduction and good health.
- 663 million people rely on unimproved sources, including 159 million dependent on surface water.
- At least 1.8 billion people use a drinking-water source contaminated with faeces.

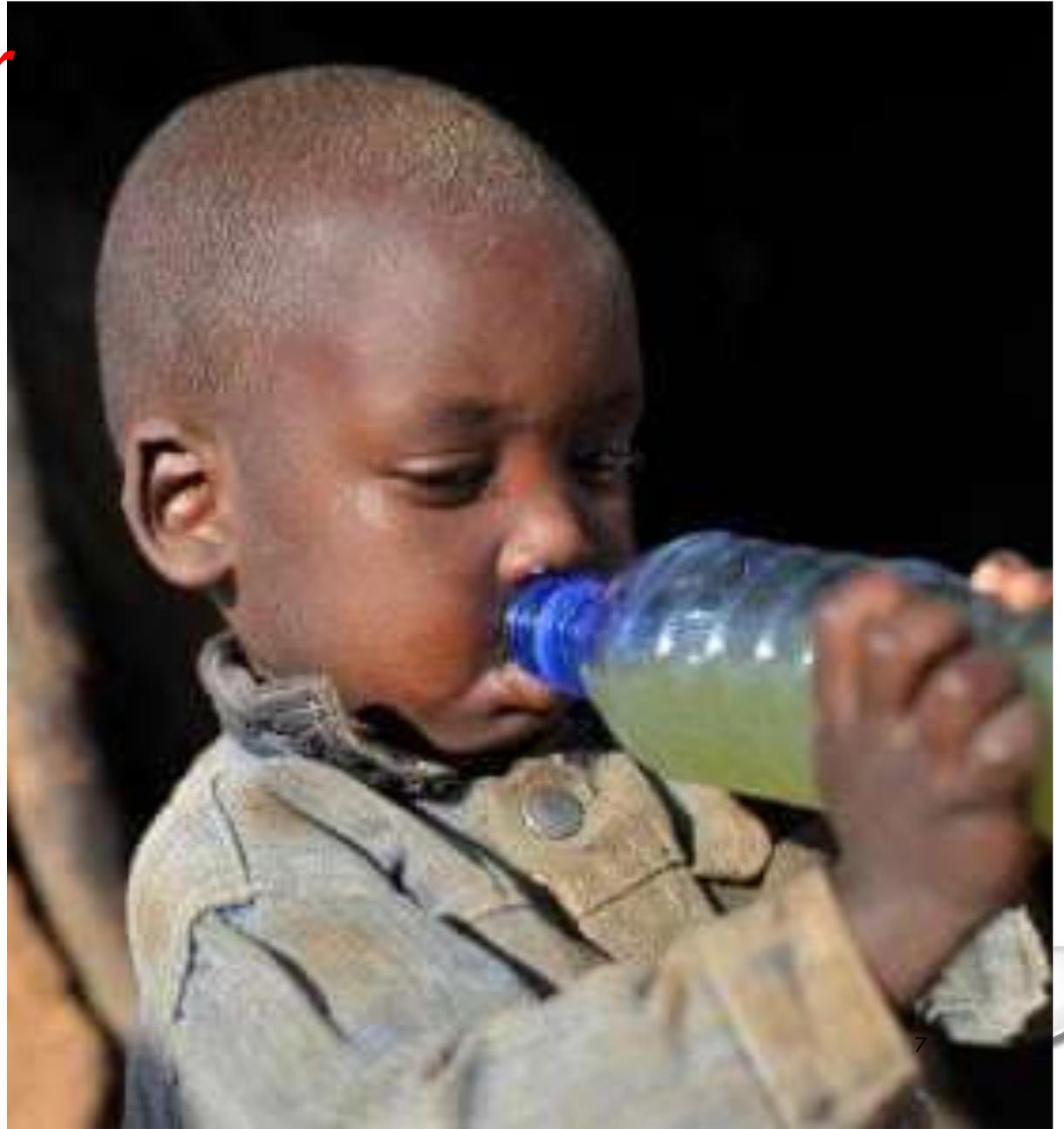
# Introduction: Key Facts

- Contaminated water can transmit diseases such as diarrhea, cholera, dysentery, typhoid and polio.
- Waterborne disease has been ranked as the leading cause of death globally, with Africa being the greatest contributor to the death toll.
- Contaminated drinking-water is estimated to cause; 502, 000 diarrheal deaths each year; childhood underweight which causes 70,000 deaths yearly.
- Every day, 6,000 children die of water-related diseases

# Sources of Drinking Water



# Sources of Drinking Water



# Conventional Water Purification Techniques

- To address these issues, conventional techniques such as chemical precipitation, solvent extraction, membrane filtration, ion exchange, electrochemical removal, coagulation techniques have been adopted.
- The challenges associated with these methods are incomplete removal of impurities, high energy efficiency requirements, availability of toxic sludge, low efficiency, sensitive operating methods and high maintenance cost.
- Alternative techniques that are low cost, scalable, benign, simple and effective

# Recommended Household Water Treatment Methods

- **Solar water disinfection (SODIS):** Utilizes the combined effects of ultra-violet radiation and heat from the sun to kill most pathogens in water. Disinfection is achieved within 6 hours to 2 days, depending on sunlight intensity and water turbidity.
- **Solar pasteurization:** This method effectively eliminates pathogens regardless of the water turbidity. This practice incorporates solar reflectors or insulators to reach temperatures of 60°C or more. Three hours is required for complete pasteurization.
- **Bio-sand filters, Chlorination and Low-cost ceramic filters**

# SODIS METHOD

1 Wash the bottle well the first time you use it.



Fill the bottle 3/4 full with water



Shake the bottle for 20 seconds



4



Now fill up the bottle fully and close the lid

Place the bottles on a black iron sheet



6

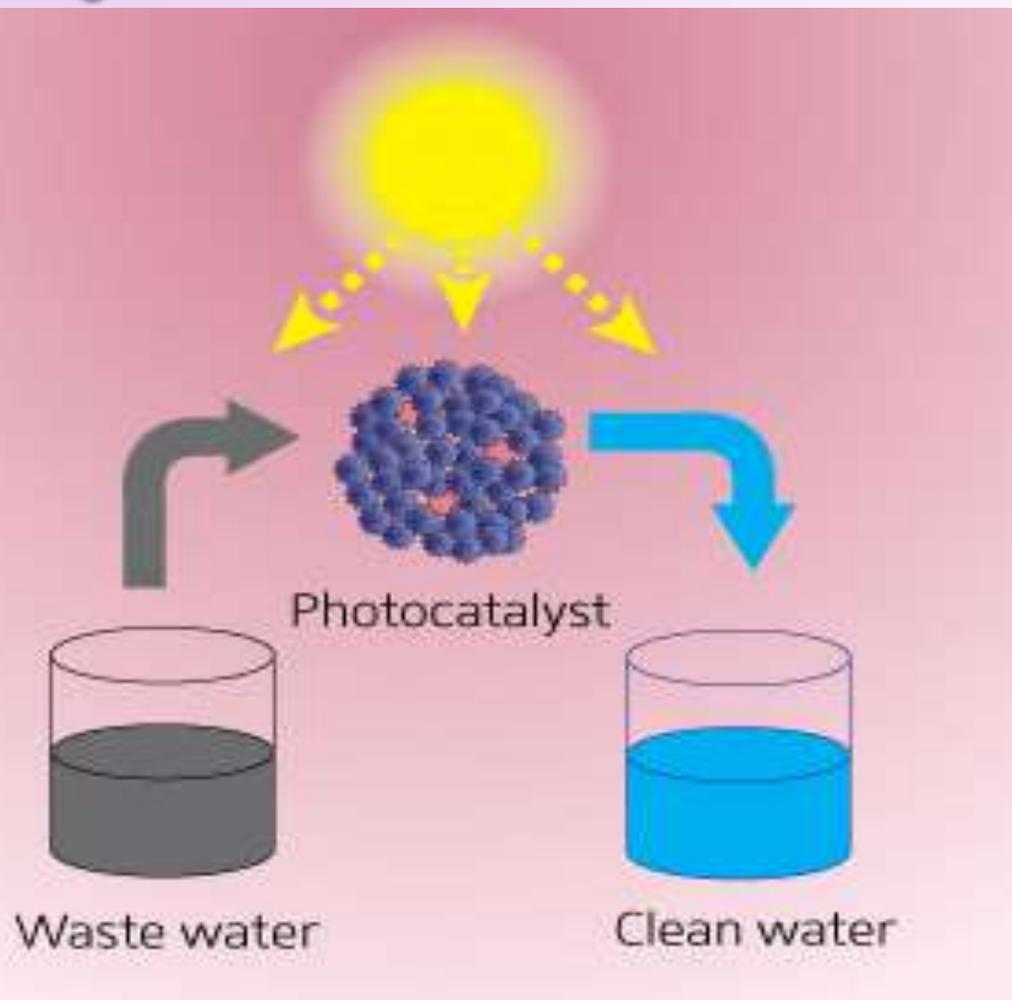


Expose the bottle to the sun from morning until evening for at least six hours

The water is now ready for consumption



# Aim: Use of photocatalysts



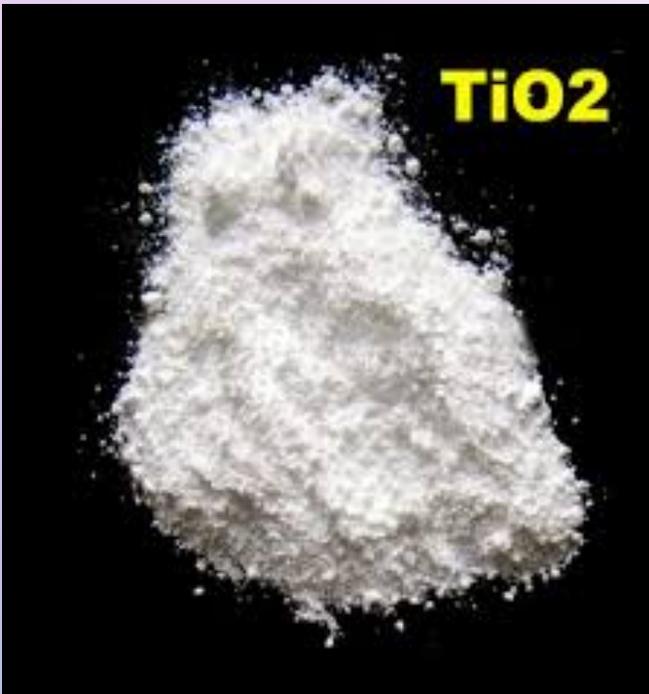
Photocatalysts decompose harmful substances using solar energy.

Speed up photo-reaction, thus reducing disinfection time.

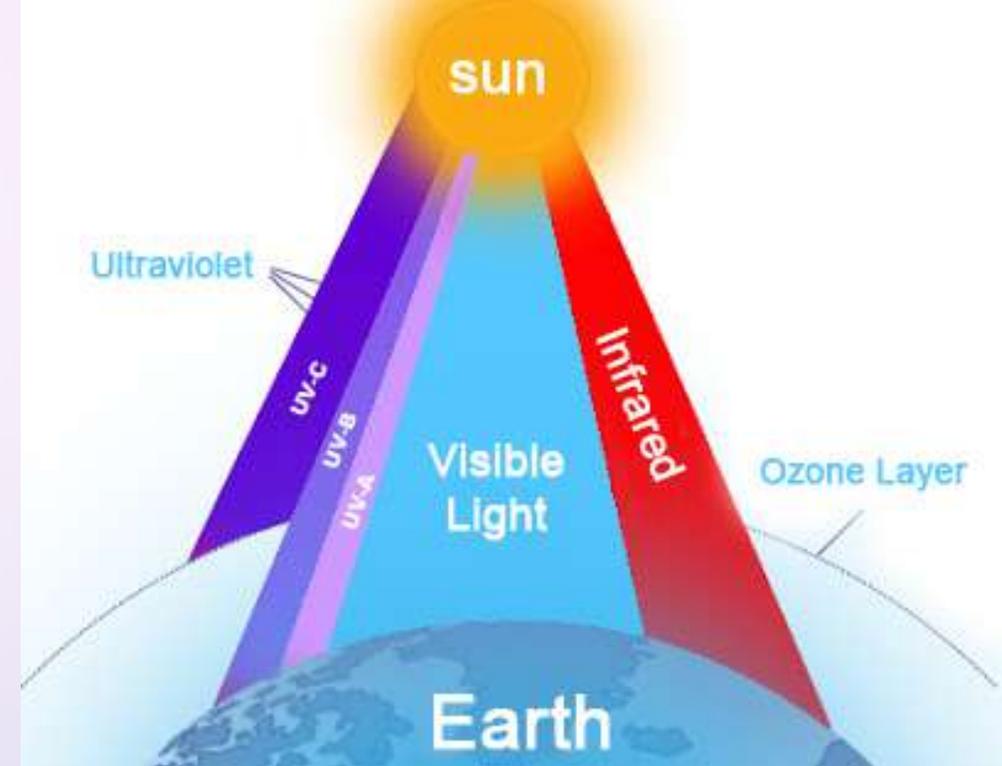
Decompose a large variety of chemical contaminants and causing fatal damage to Pathogens.

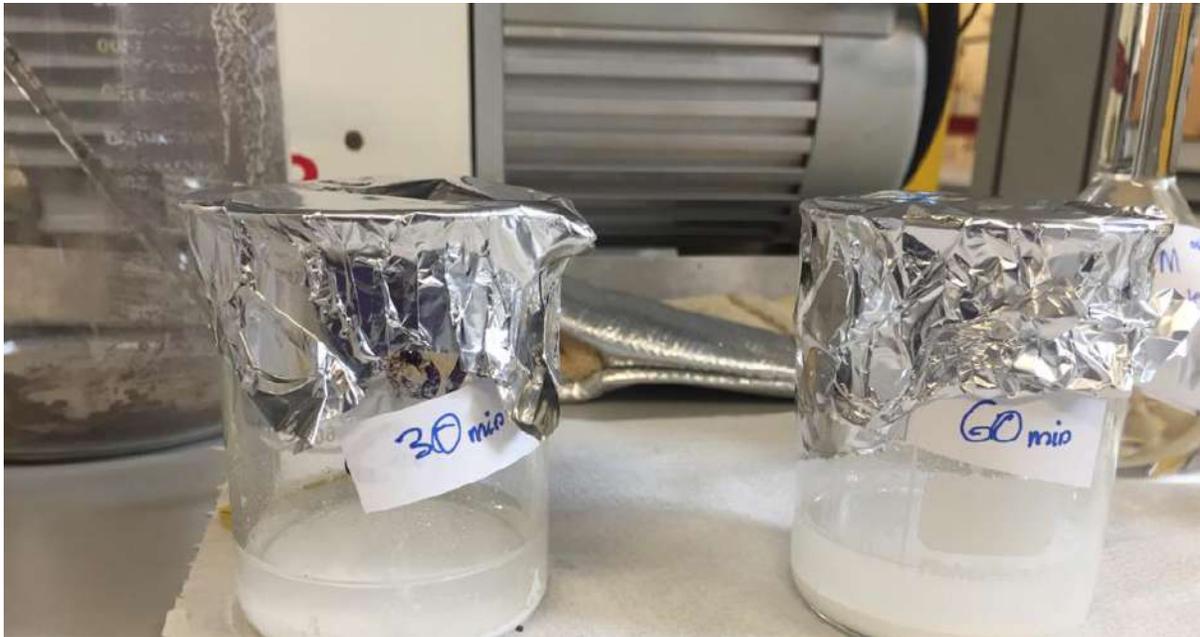
Low cost, environmentally friendly, easy to prepare.

# Lab Work



- Active in the UV region
- Enhance optical properties (introducing other elements)
- Simple kitchen equipment like microwave and oven
  - Over 90% removal of chemical pollutants achieved (<1 hr)
  - Potent at killing pathogens (Pathology Dept.)





# Tanzania Project – Field Work

majicom



- Vingunguti is a shanty town with approximately 100,000 residents.
- Government is not able to send social and economic infrastructure.
- The construction of traditional sewerage systems is hampered by high construction cost, a high-water table and high fees associated with adequate waste disposal.
- This has resulted in sewage overflows which pollute the water bodies used by the inhabitants.
- Leading to frequent outbreaks of water-borne diseases.

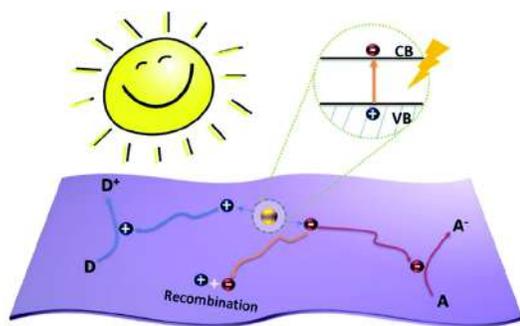
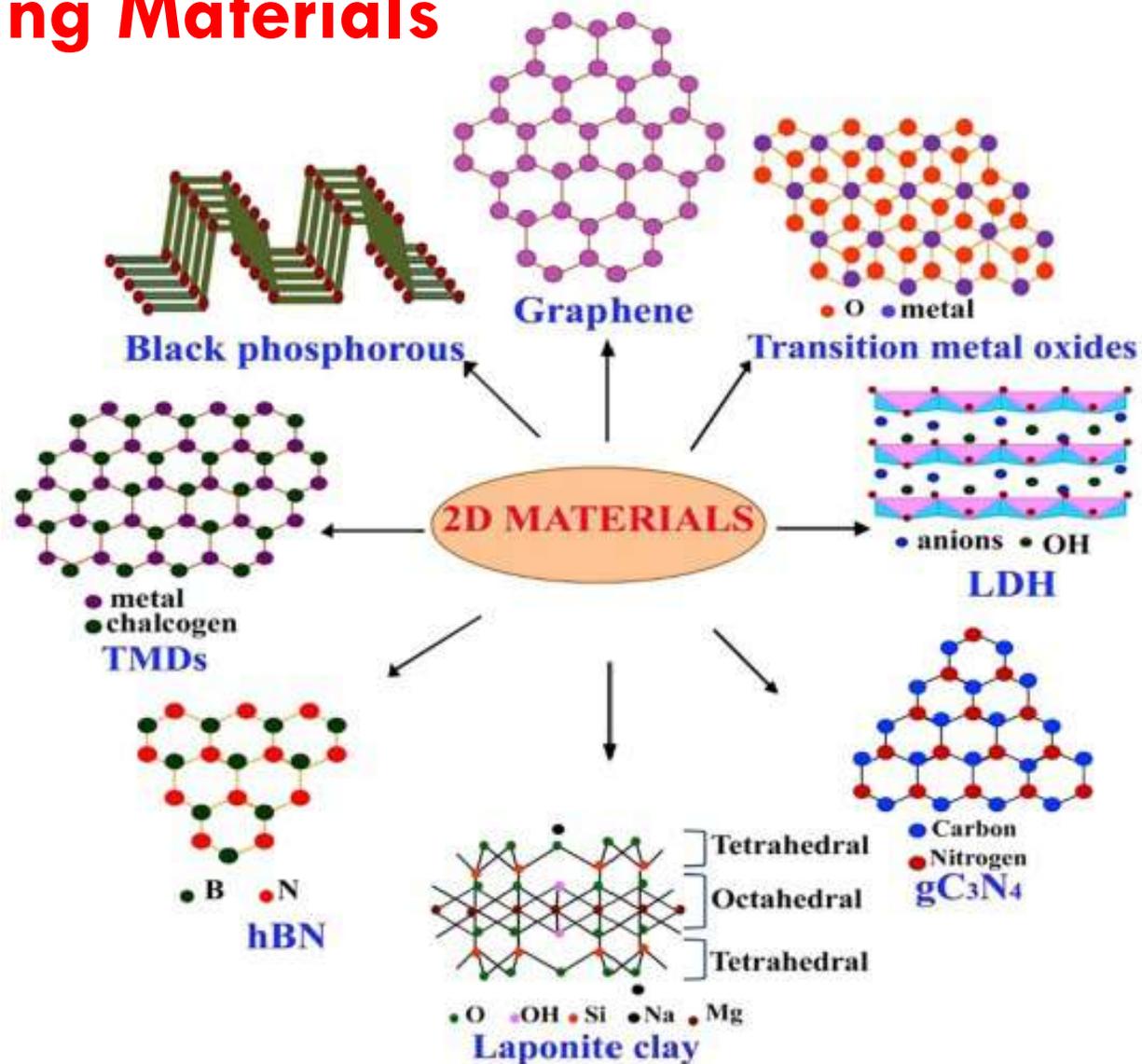
# Examples of Nanoparticles

Nanoparticle/nanomaterial	Pollutant	Reference
Nanocrystalline TiO <sub>2</sub>	Metal ions	Pena et al. (2005)
Nitrogen (N)-doped TiO <sub>2</sub>	Azo dyes	Liu et al. (2005b)
Fe(III)-doped TiO <sub>2</sub>	Phenol	Nahar et al. (2006)
Supported TiO <sub>2</sub> nanoparticles	Aromatic pollutants	López-Munoz et al. (2005)
Silver-doped titanium dioxide nanoparticles	Bacteria	Liga et al. (2011)
Manganese-doped ZnO NPs	Methylene blue	Ullah and Dutta (2008)
Nanotubes Bi <sub>2</sub> O <sub>3</sub>	Chromium ions	Qin et al. (2012)
Bi <sub>2</sub> O <sub>3</sub> and Au/Bi <sub>2</sub> O <sub>3</sub> nanorods	Orange II dye	Anandan et al. (2010)
CeO <sub>2</sub>	Dyes	Zhai et al. (2007); Ji et al. (2009); Borker and Salker (2007)
Nanocomposite plasmonic photocatalyst Ag–AgCl/CeO <sub>2</sub>	Methyl orange	Wang et al (2011)
Nano WO <sub>3</sub>	<i>Escherichia coli</i>	Gondal et al (2009)
Photocatalyst CdS coated with CdS nanoparticles	Dyes and phenolic compounds	Yang et al. (2009)
ZnS nanoporous nanoparticles	Eosin	He and Zhao (2005)

# Other Interesting Materials

## Sheet-like

- Photocatalyst
- Nano-filters



# Conclusion

- Consumption of contaminated drinking water can compromise food security
- Using photocatalysts, it's possible to harness the abundant and sustainable energy of the sun for water purification.
- Africa has a large **solar** potential due to its geographical location.
- Prevent or reduce the outbreak of water-borne diseases.



**THANK YOU VERY MUCH FOR YOUR ATTENTION**