Knowledge Transfer Office
香港城市大學
City University of Hong Kong

Technology Brief of CityU's IP

- A Metallic Glass (MG) Catalyst for Wastewater Treatment (IDF# 715; US 16/448,218)
- A Boron Carbide-based Aerogel Foam for Water Evaporation (IDF# 872; US 63/078,389)

8 July 2021

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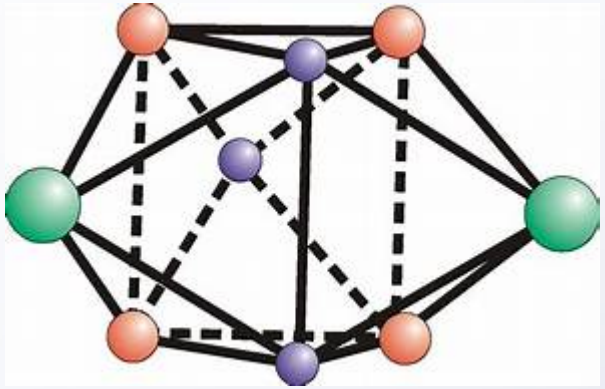
A Metallic Glass (MG) Catalyst for Wastewater Treatment

Background:

- Global Wastewater Treatment Market: ~ USD 18 billion by 2026
- Wastewater Treatment Technologies
    - Sedimentation
    - Filtration
    - Disinfection

- Metallic Glass (or Amorphous Metals)
    - Non-crystalline Structure;
    - Disordered Atomic Packing Arrangement
    - High Catalytic Efficiency (usually low stability)



A Metallic Glass (MG) Catalyst for Wastewater Treatment

$Fe_{83}Si_2B_{11}P_3C_1$:

- Non-noble;
- Catalytic Efficiency
- Remarkable Stability & Reusability

- In-situ Self-supported Hierarchical Gradient Structure
  - ➢ a top porous sponge layer
  - ➢ a thin amorphous oxide interfacial layer
  - ➢ MG surface

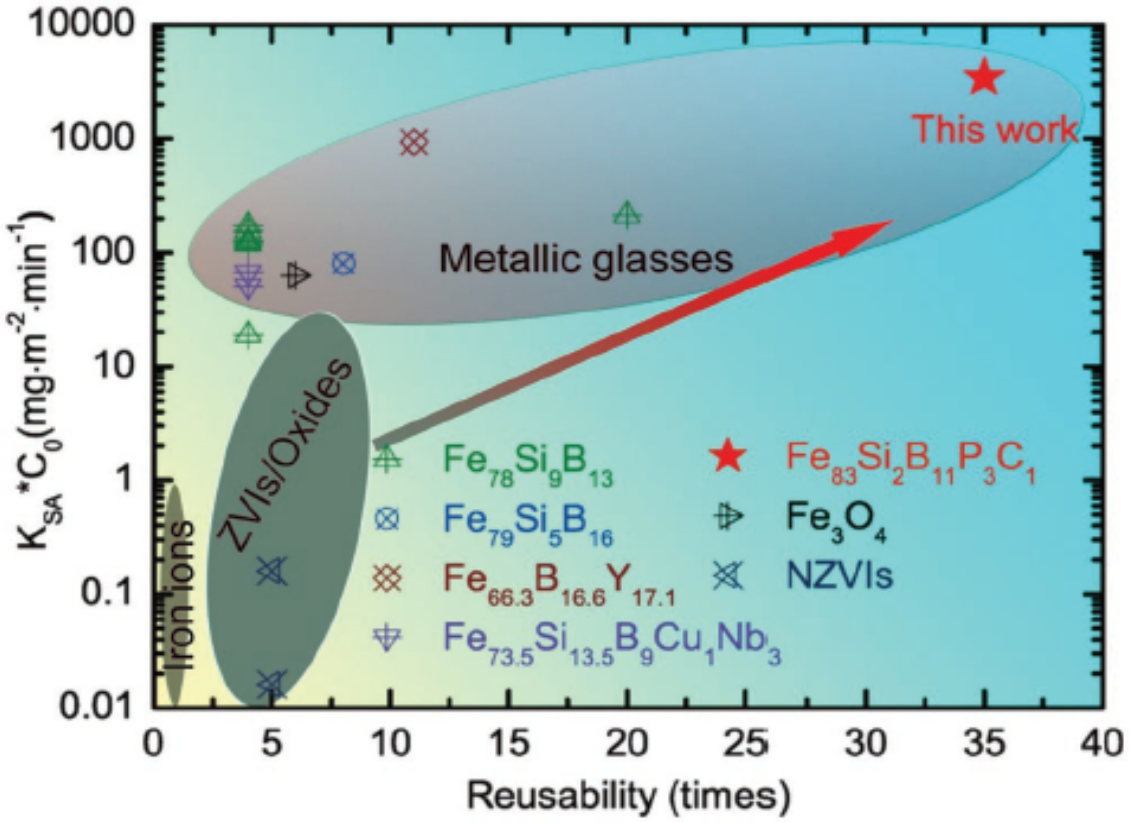


Figure 2. Comparison of catalytic performance. Degradation capability versus reusability for various amorphous and crystalline catalysts. Reusability of Fe ions is regarded as one time due to their nonreusability. An excellent catalyst should possess both high degradation efficiency and long reusability (top right-hand area) (more details are presented in Table S1 in the Supporting Information).

A Metallic Glass (MG) Catalyst for Wastewater Treatment

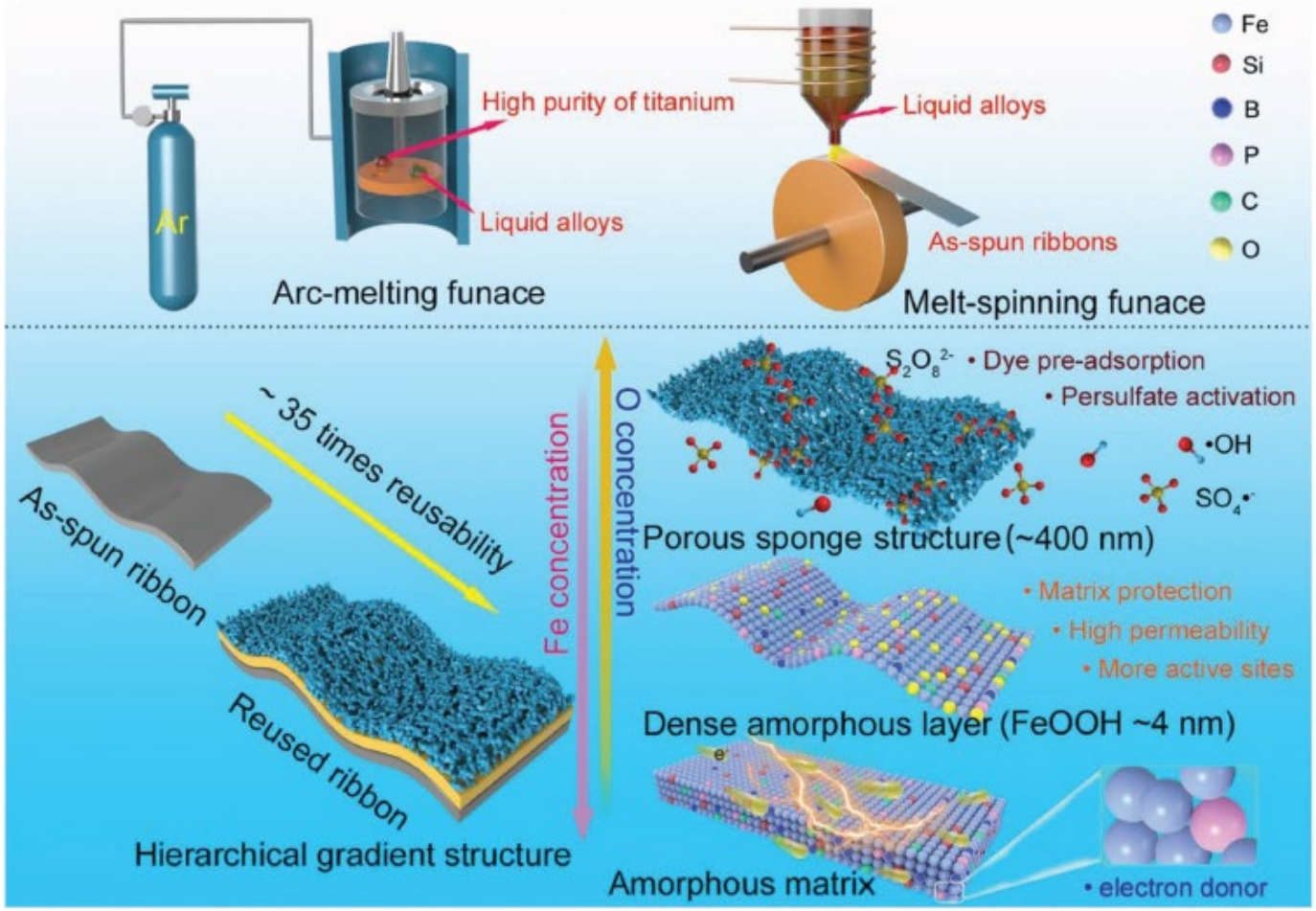
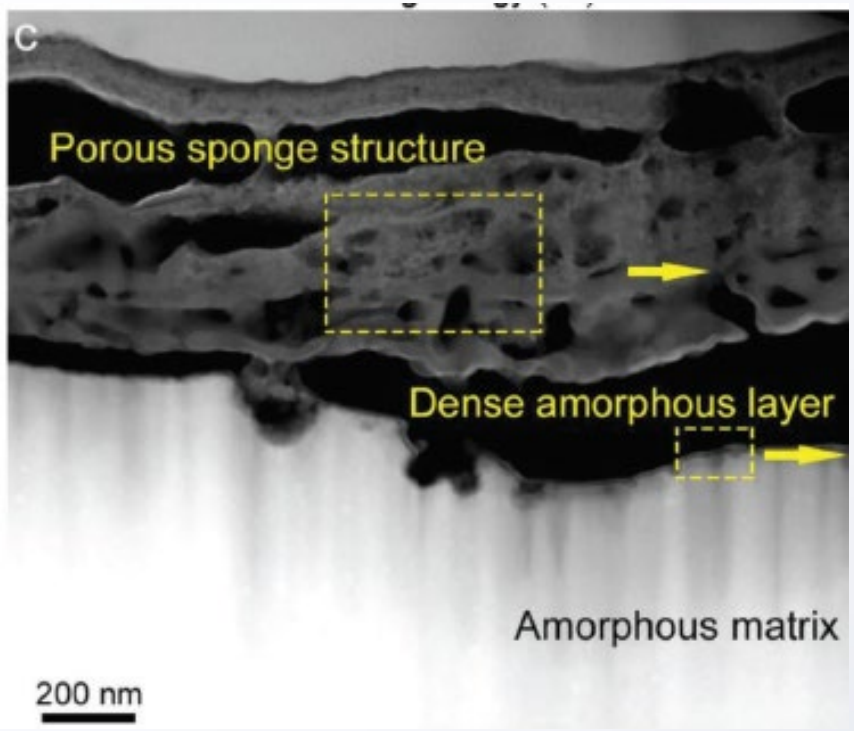


Figure 4. Schematic diagram. Surface and structural variation of as-received and reused $Fe_{83}Si_2B_{11}P_3C_1$ glassy ribbon catalysts contributing to catalytic reaction mechanism.



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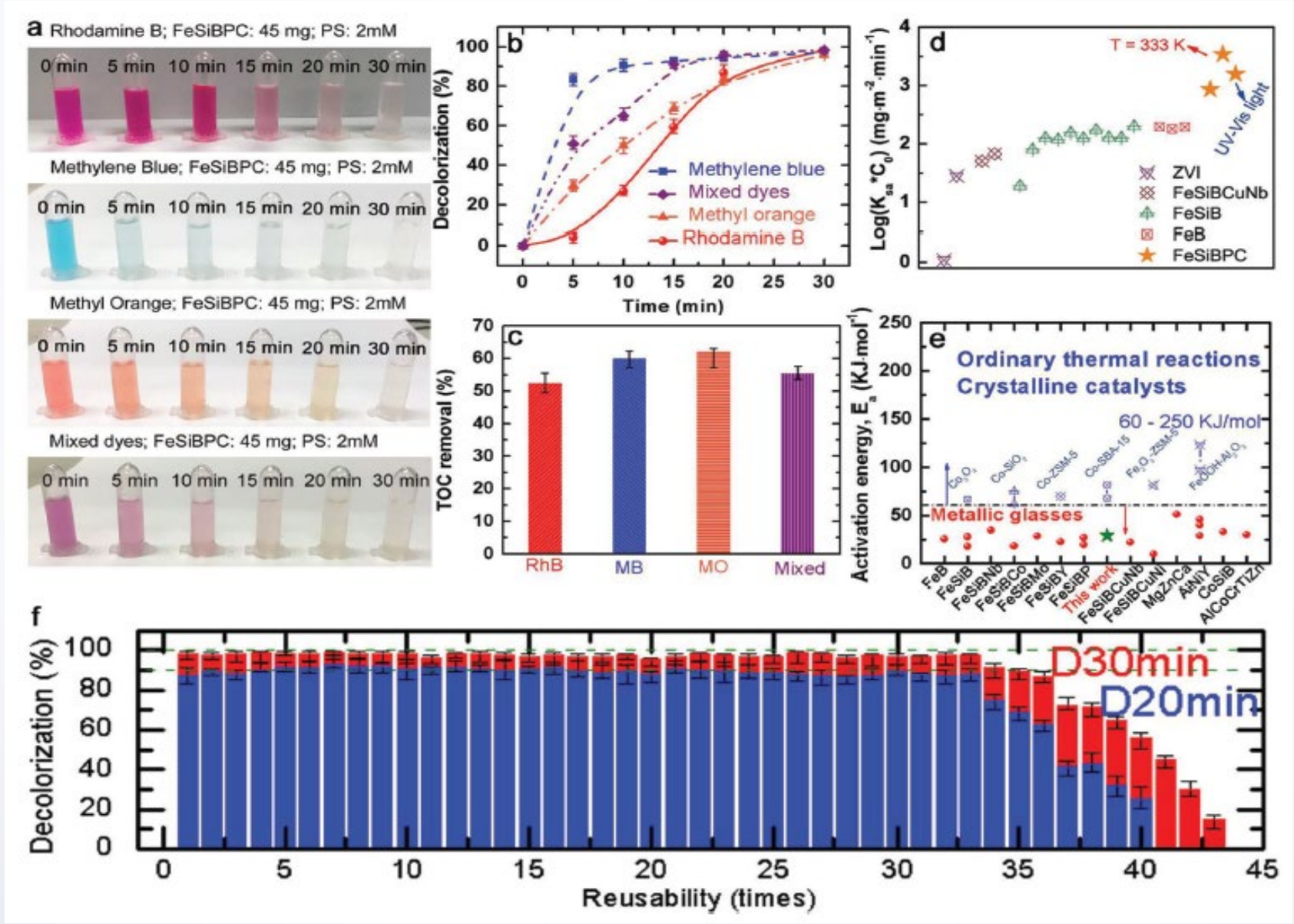


A Metallic Glass (MG) Catalyst for Wastewater Treatment

Advantages:

- Relatively Low Cost on Materials and Fabrication Method
- Glassy Ribbons, Flexibly manufactured by factory
- No Heating, UV-radiation, Ionization or pH concentration
- Relatively High Degradation Efficiency vs Long Reusability

Application:

- System or Apparatus of Wastewater Treatment
- Degradation of Organic Waste from Industry and Residence

[Ref.] https://www.onlinelibrary.wiley.com/doi/10.1002/adfm.201807857

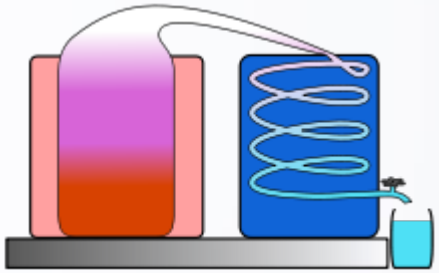
Thank you!

Q&A

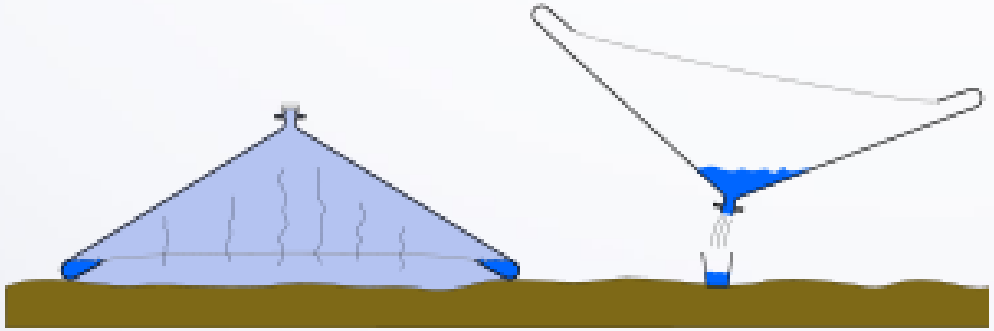
A Boron Carbide-based Aerogel Foam for Water Evaporation

Background:

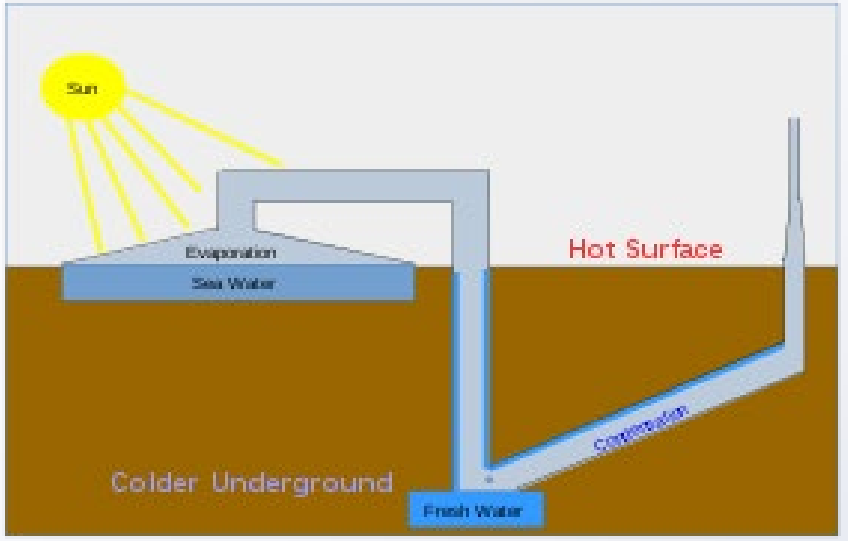
- Distillation / Filtration to purify sea- or waste-water for freshwater
  - ➢ Great Energy Consumption;
  - ➢ High Cost-to-Performance vs Material;
  - ➢ Less Economical and Environmental Friendly;



- Water Evaporator by Solar Energy



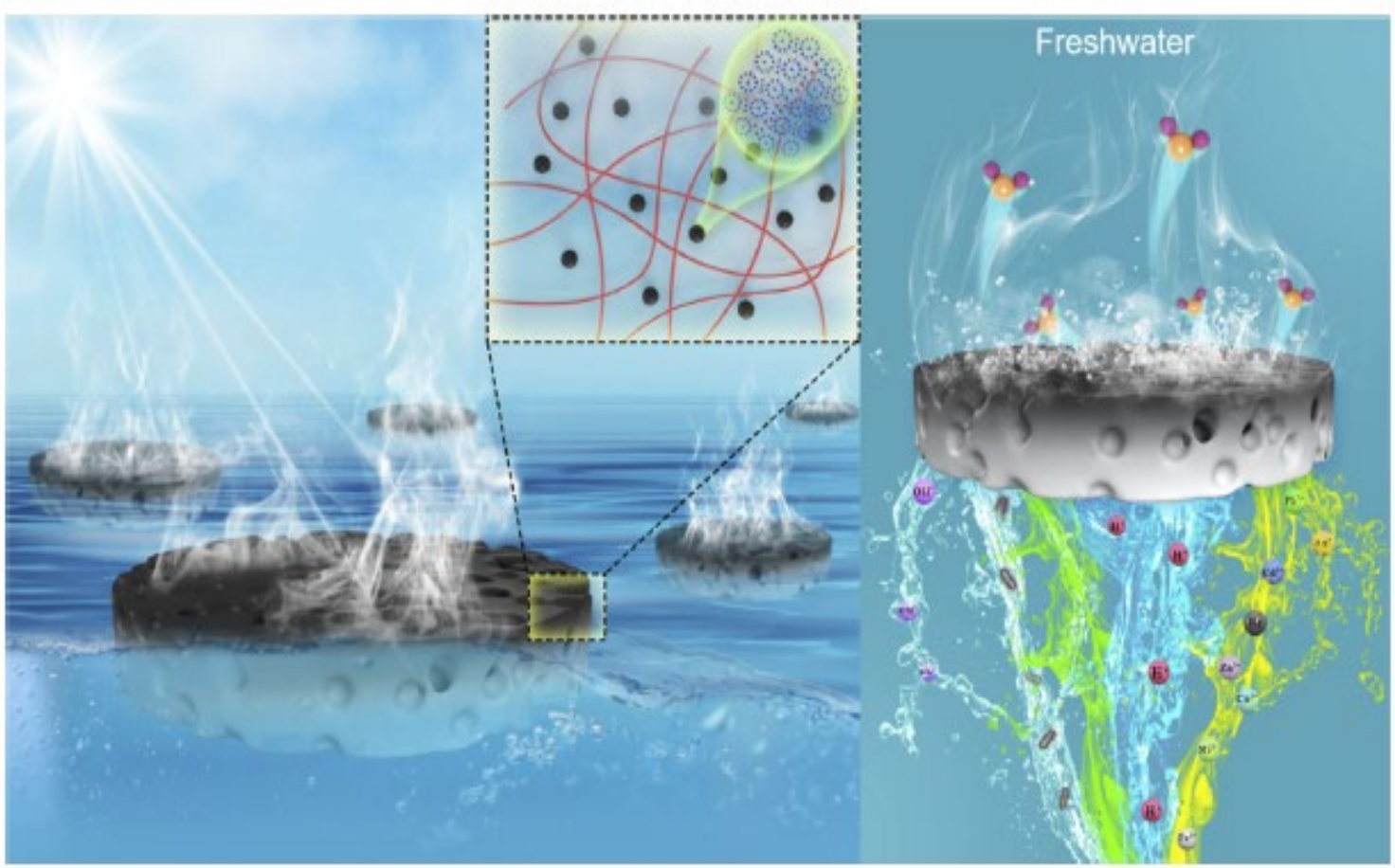
Sponge hydrogel/ algae



A Boron Carbide-based Aerogel Foam for Water Evaporation

Boron Carbide Bilayer Foam (BCBF):

- Boron Carbide B_4C;
- Bilayer Structure;
- Heat-shielding;
- Porous Polymer Framework;
- Good Hydrophilic Wettability;



Scheme 1. Schematic illustration of solar water evaporation and wastewater purification using the boron carbide bilayer foam.

A Boron Carbide-based Aerogel Foam for Water Evaporation

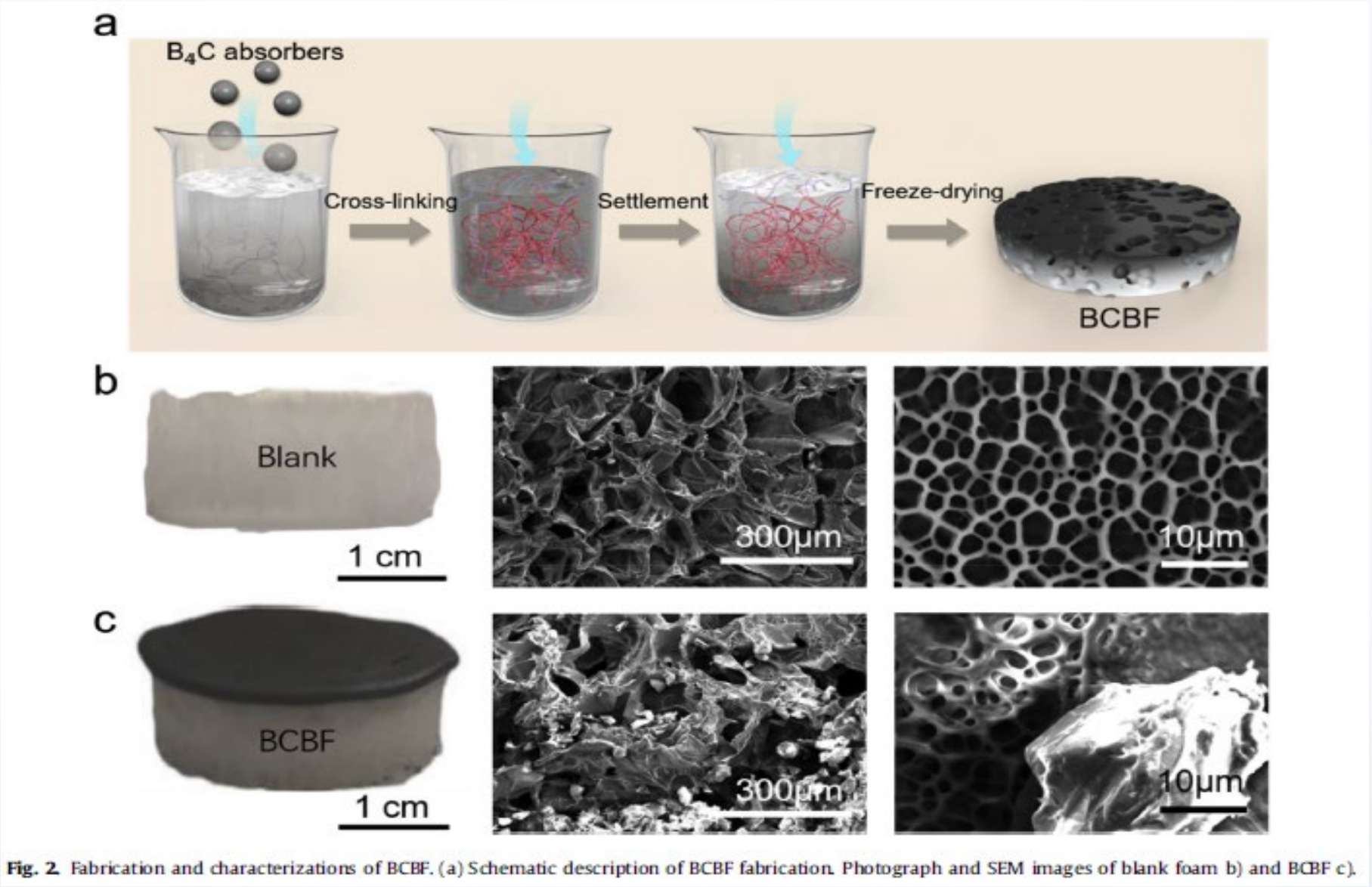
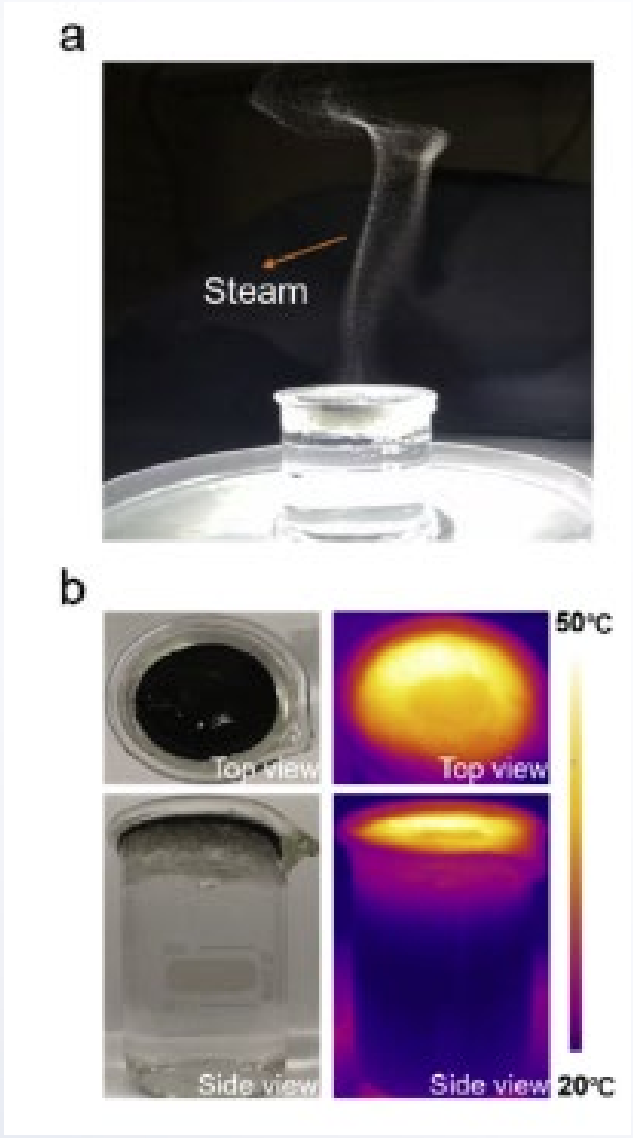
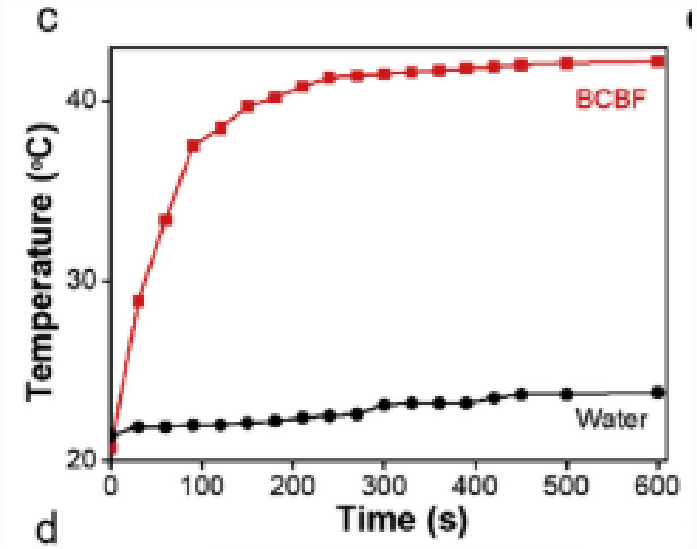
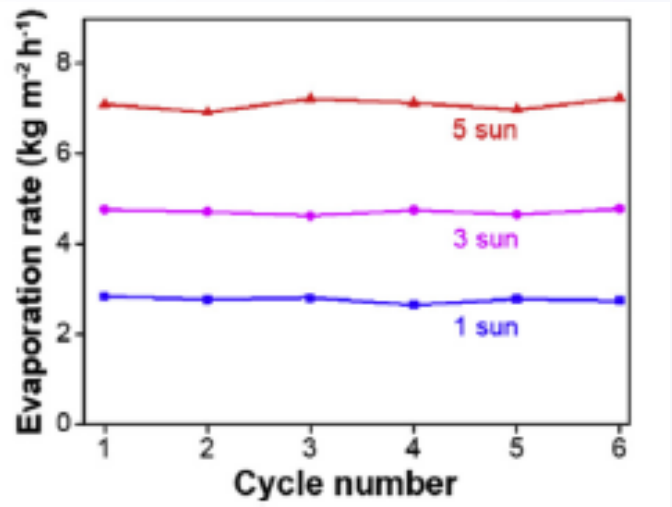


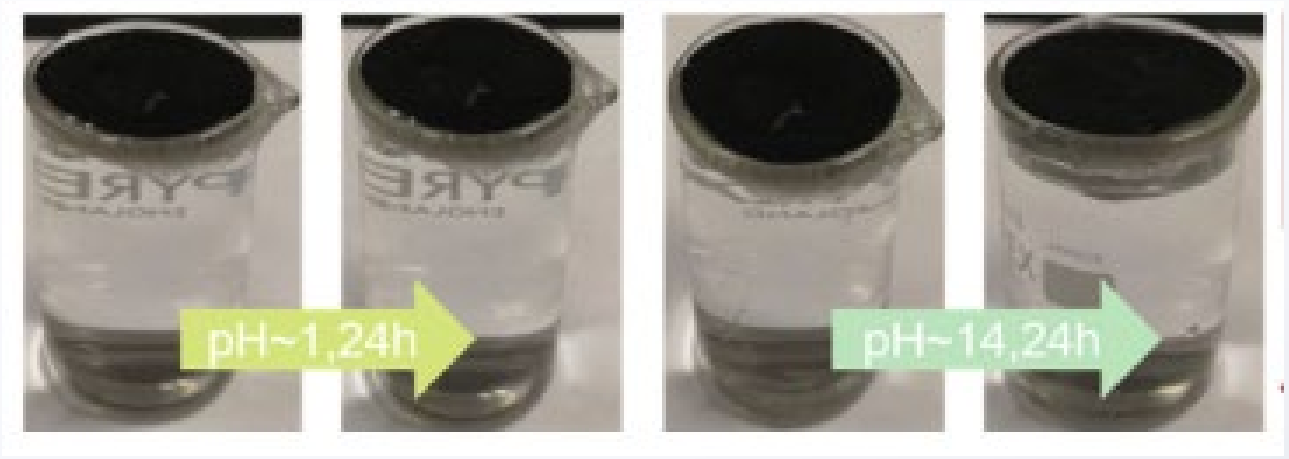
Fig. 2. Fabrication and characterizations of BCBF. (a) Schematic description of BCBF fabrication. Photograph and SEM images of blank foam b) and BCBF c).

A Boron Carbide-based Aerogel Foam for Water Evaporation









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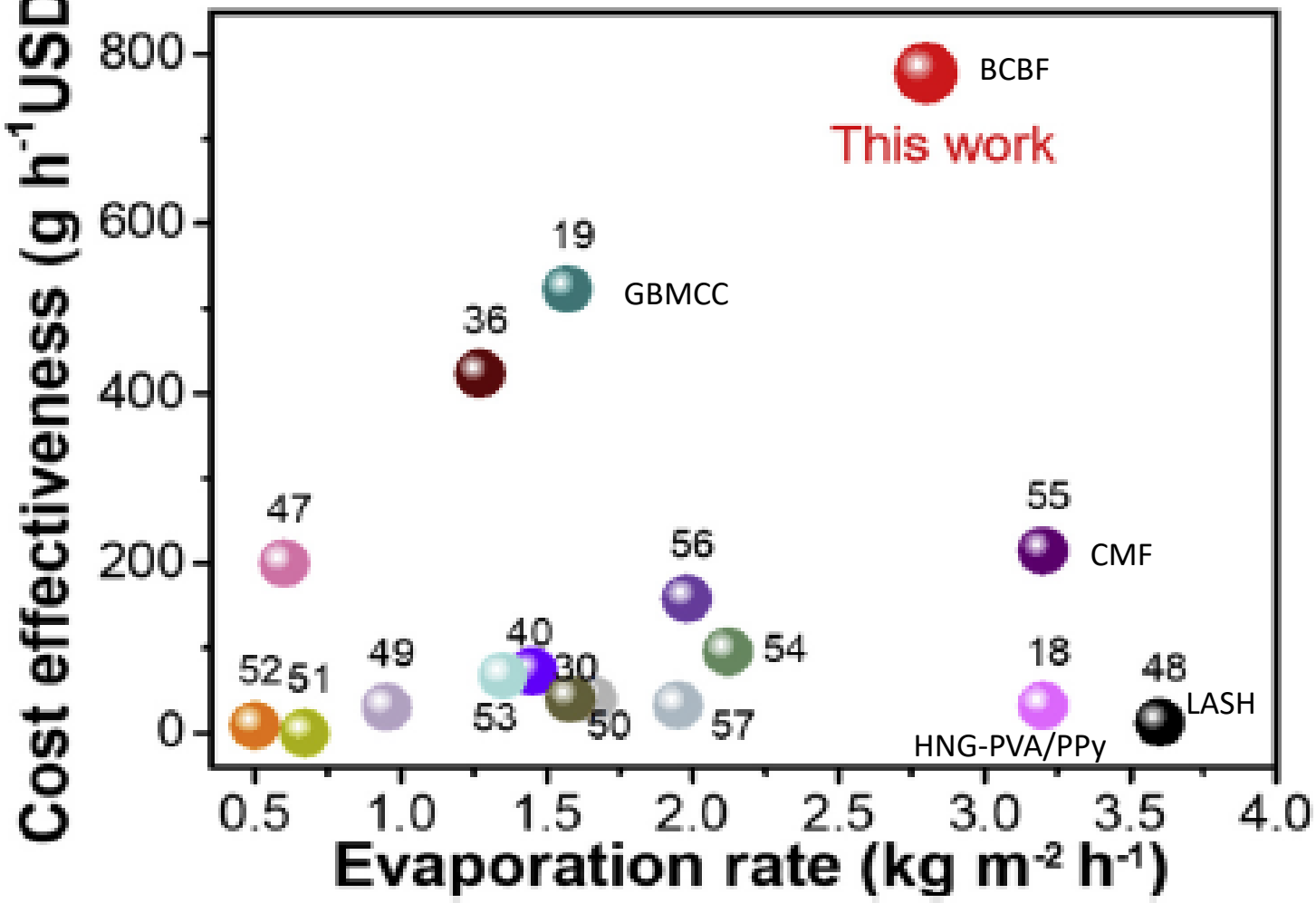

Fig. 5. Cost-effectiveness comparison of current reported solar evaporators.

A Boron Carbide-based Aerogel Foam for Water Evaporation

Advantages:

- Low Material Cost & Simple Technique for Fabrication
- Work Well in Wastewater with Heavy Metal, Dyes & Micro-organisms;
- Work under Extreme Conditions, Acidic, Alkaline & Saline
- High Efficiency of Evaporation Rate vs.. Cost-effectiveness

Application:

- Seawater Desalination for Fresh Water;
- Wastewater Purification by Solar Energy

[Ref.] https://www.sciencedirect.com/science/article/pii/S2468606920301179

Thank you!

Q&A