APPROACH

Carbon Dots and Their Role in H_2O_2 Production: A Breakthrough in Water Purification and Stabilization Technology

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OUTLINE

- The Problem & Opportunity
- The Solution – Research Innovation
- Impact
- Call to Action

The Problem & Opportunity

Global Market and Uses of Hydrogen Peroxide: Key Facts and Trends

- **Production and Consumption**: Annually 5–6 million tons, market value of USD 4–7 billion
- **Environmental Benefits**: Breaks down into water and oxygen, leaving no toxic residues
- **Emerging Applications**: Food processing, **agriculture, water treatment** and **water storage** are gaining importance

Why H_2O_2?

- **Elimination of Microorganisms and Biofilms**
- **Oxygenation and Enhanced Plant Growth**
- **Reduced Chemical Load**
- **Pathogen and Algae Control in Closed Systems**
- **Versatile Use and Safety**

The Solution

Closed-Loop Photocatalysis: In-Situ Peroxide Production for Sustainable Water Treatment

Photocatalytic carbon dots generate hydrogen peroxide in situ; there is **no need for an external** chemical supply.

✓ **Uniqueness?**

Cost-effective, highly stable, and can be engineered to optimize light absorption, resulting in efficient H_2O_2 production under mild conditions.

✓ **Improvement?**

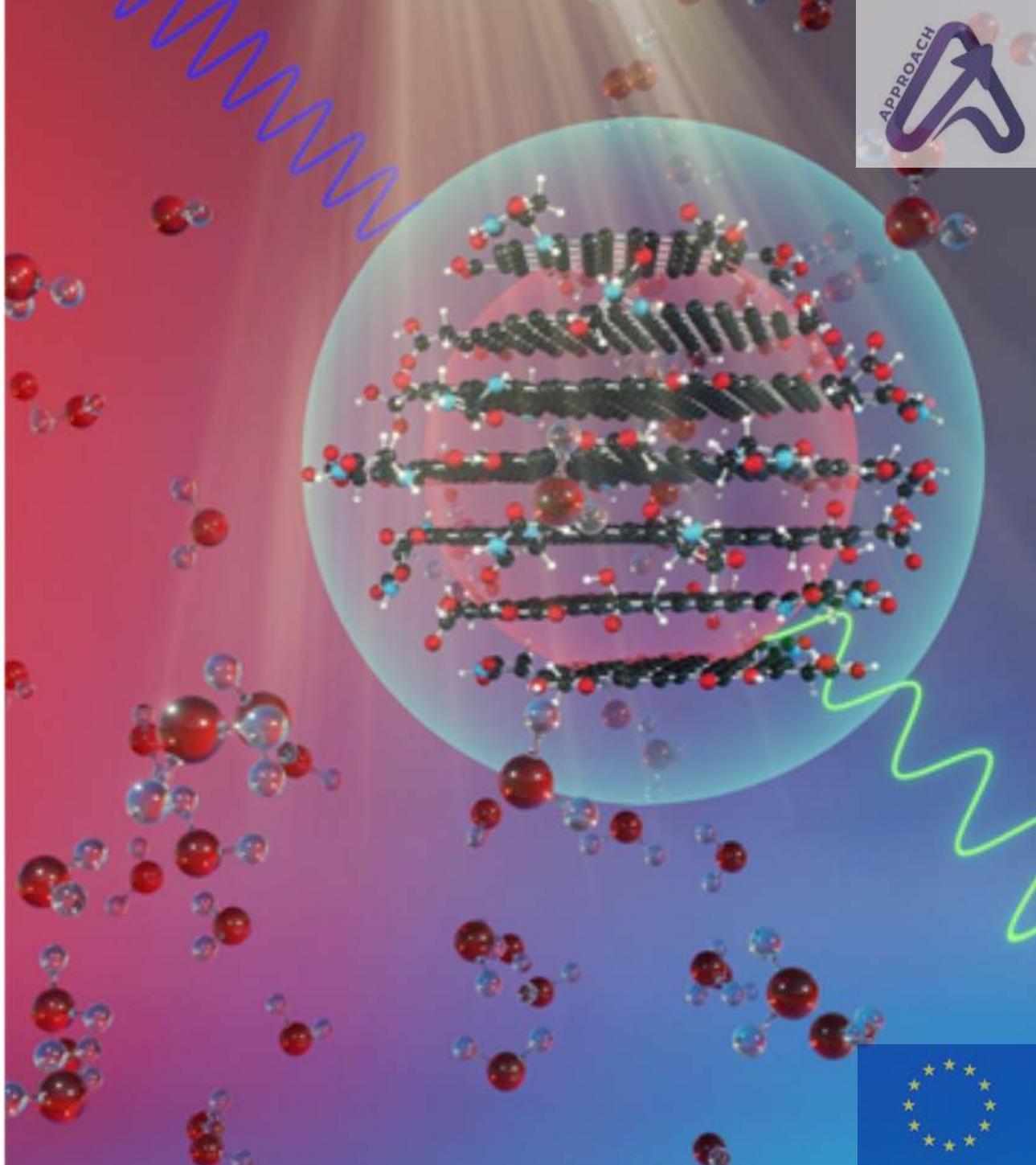
Reduced costs (buying, transporting, and storing)

Minimal environmental impact

Scalable and flexible

✓ **Feasibility?**

CDs provide stable and reproducible generation of H_2O_2 with consistent photocatalytic activity.



Impact

Closed-Loop Photocatalysis: In-Situ Peroxide Production for Sustainable Water Treatment

- **Continuous On-Site H_2O_2 Generation**
  Reduces reliance on external peroxide supplies, significantly lowering operational costs and handling risks.

- **Closed-Loop Operation**
  Minimizes waste and chemical leakage, benefiting sectors such as agriculture, food processing, and water treatment.

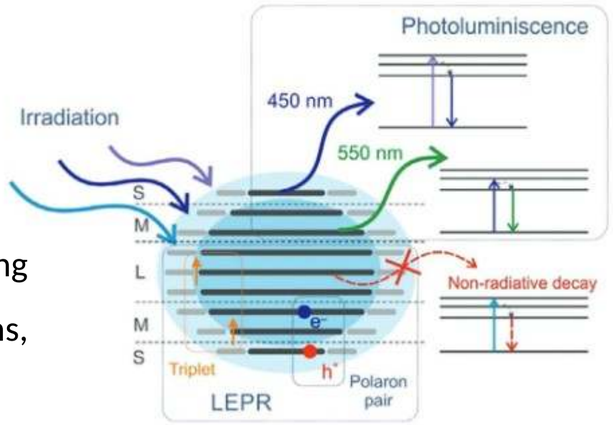
- **Sustainable Technology**
  Aligns with EU green objectives by reducing CO_2 emissions, cutting down on transport-related energy consumption, and supporting circular economy principles.

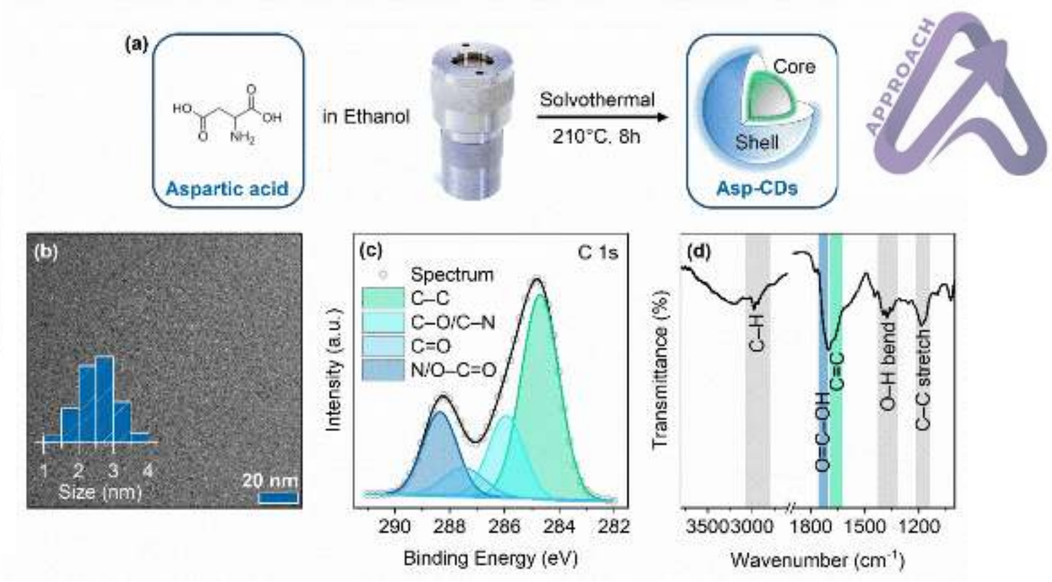
- **Flexibility and Easy Integration**
  Facilitates decentralized operations, making it easier to integrate renewable energy sources and reduce environmental footprints.

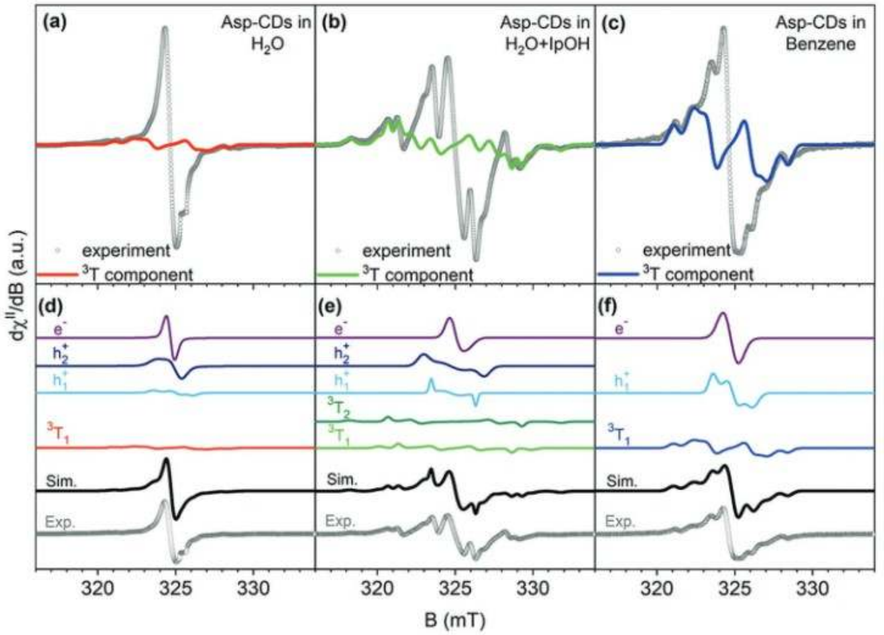
- **High Efficiency and Purity**
  Produces peroxide directly from water and oxygen, ensuring consistent quality and reducing reliance on fossil-based or import-heavy supply chains.

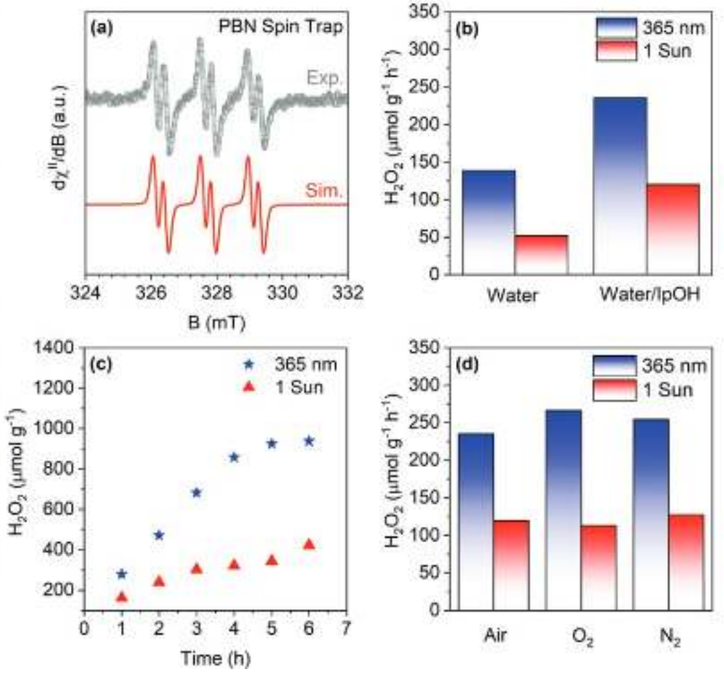
Call to Action

1. **Lab-Scale Validation**
2. **Prototyping**
   - Design a small-scale prototype reactor mimicking real-world water treatment (e.g., hydroponic systems, greenhouse irrigation)
3. **Industrial Feasibility Testing**
   - Gather performance data on H_2O_2 yields and operational costs under semi-field conditions
   - Partner with industry (agriculture, aquaculture, water management) to integrate prototypes into existing infrastructure
   - Feedback on reliability and cost-effectiveness to refine technical parameters (flow rates, reactor design, etc.)
   - Establish manufacturing partnerships for mass production of reactors and catalyst materials.









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THANK YOU

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