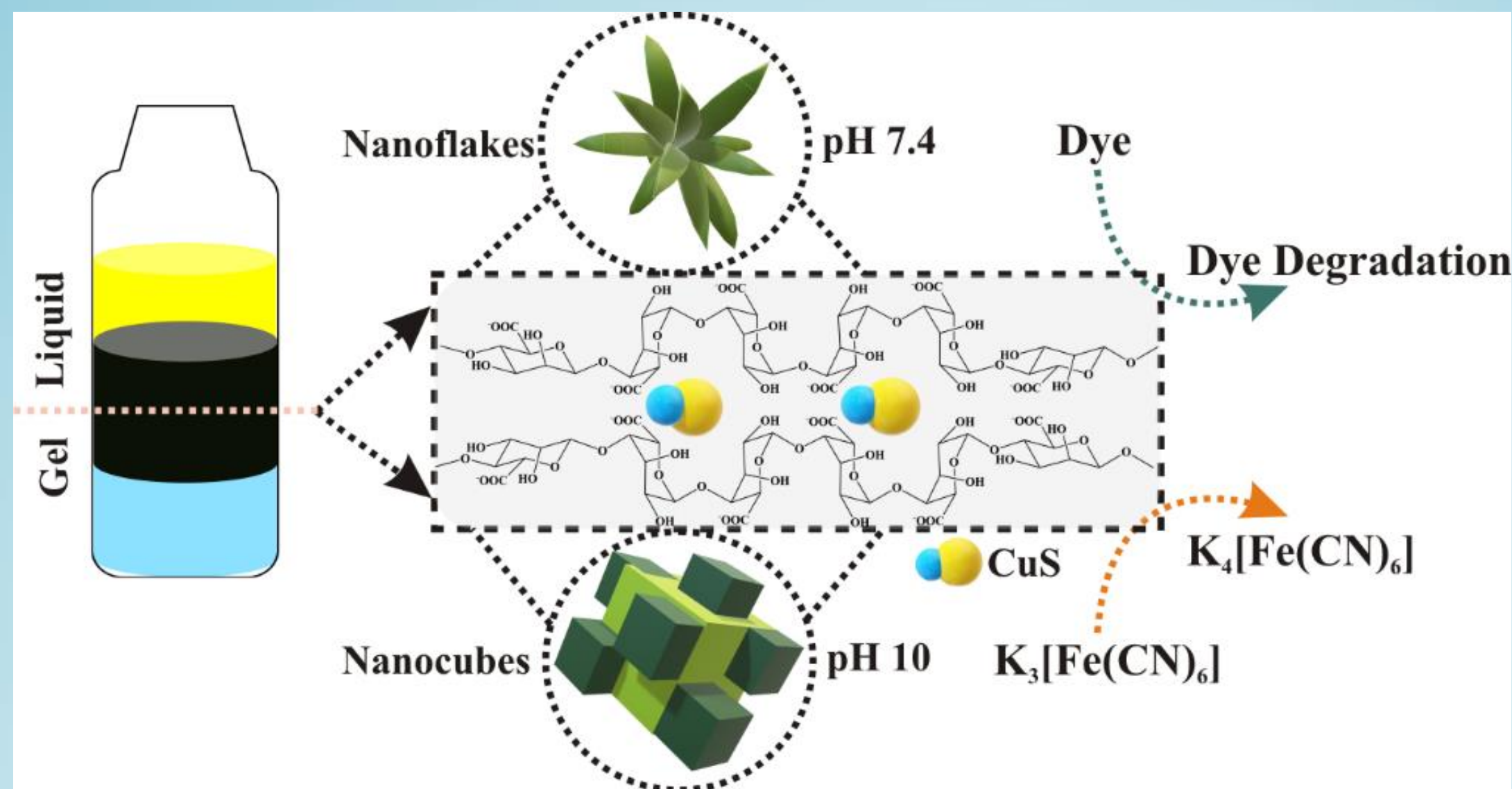
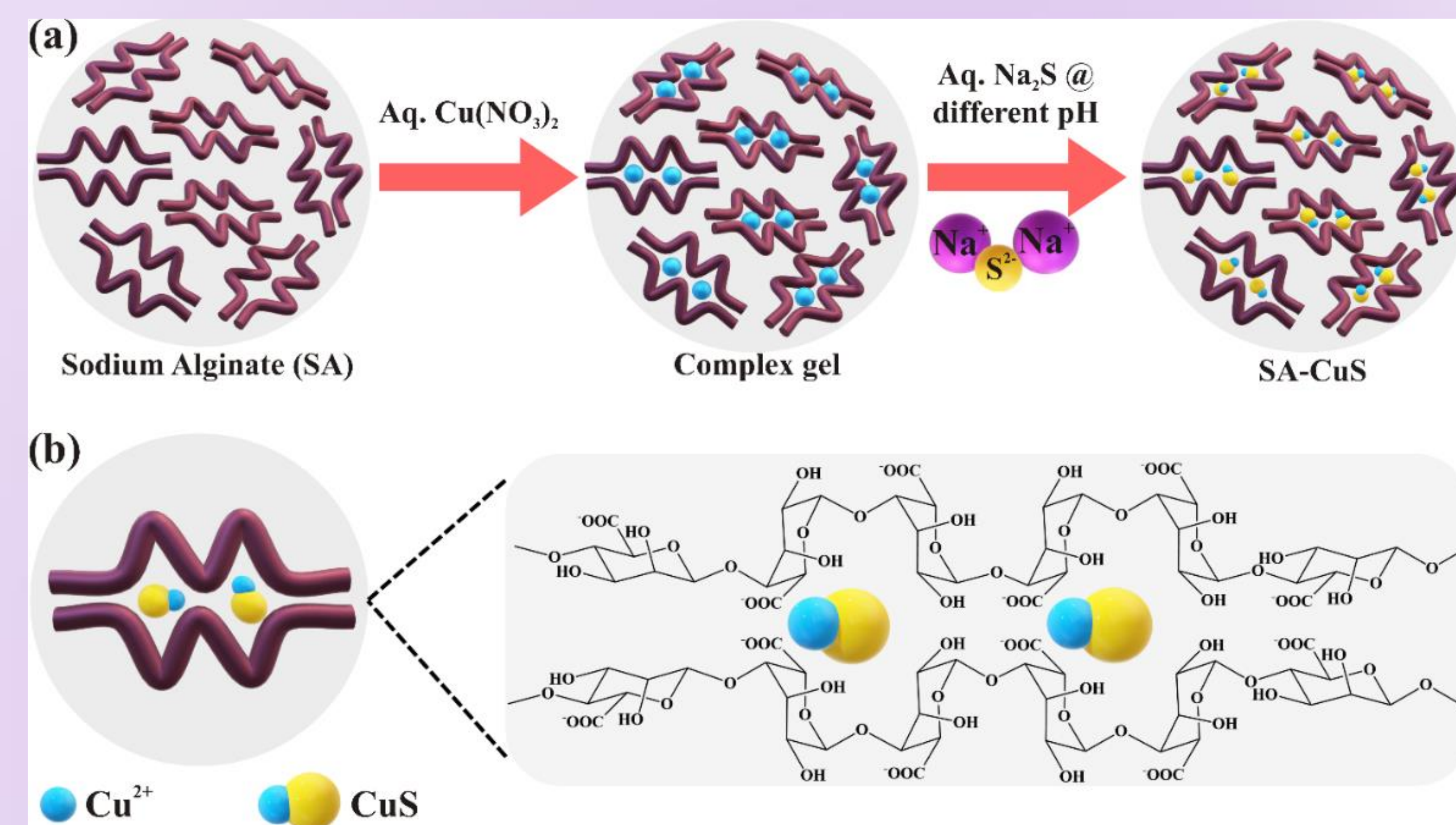


ABSTRACT



Gels are an excellent reaction medium for the synthesis of nanomaterials because they represent the transition phase that exists between solids and liquids. In this study, CuS nanostructures are grown at the gel-liquid interface using an environmentally sustainable sodium alginate gel as a reaction media. The morphology of the CuS nanostructures is tailored by controlling the pH of the reaction media. CuS nanoflakes obtained at a pH of 7.4, transformed into nanocubes at 10, and deformed at a pH of 13. Powder X-ray diffractograms show that the CuS nanostructures are organized in a hexagonal crystal system. The +2 and -2 oxidation states of the Cu and S ions, respectively, are verified by the high-resolution XPS spectra. A huge proportion of greenhouse CO₂ gas was physisorbed by the CuS nanoflakes. CuS nanoflakes developed at a pH of 7.4 had a lower bandgap than CuS nanostructures developed at pH 10 and 13, resulting in a faster photocatalytic degradation of 95% crystal violet and 98% methylene blue in aqueous dye solutions, respectively, in 60 and 90 minutes when illuminated with blue light. Additionally, the sodium alginate-CuS nanoflakes exhibit outstanding performance in photo-redox processes to convert ferricyanide into ferrocyanide.

Introduction



Developing metal sulfide-based nanostructures involving no additional energy but utilizing biocompatible polymer gel-based materials, where the structures originate at the interface and progress deep within the gel phase by the gradual diffusion of reactant particles. These structures can result in hierarchical porosity along with a high surface area. The Cu²⁺ ions, when incorporated into the aqueous SA (sodium alginate) solution, result in the formation of the complex gel. Further, the aqueous sodium sulfide (Na₂S) was inserted into the complex gel, which yields SA-CuS nanostructures at the gel-liquid interface. The formation of SA-CuS nanostructures at the gel-liquid interface is further investigated by varying the pH of the precursor solution (aq. Na₂S). The obtained SA-CuS systems at different pHs, i.e., 7.4, 10, and 13, are labeled SA-CuS@pH7.4, SA-CuS@pH10, and SA-CuS@pH13, respectively.



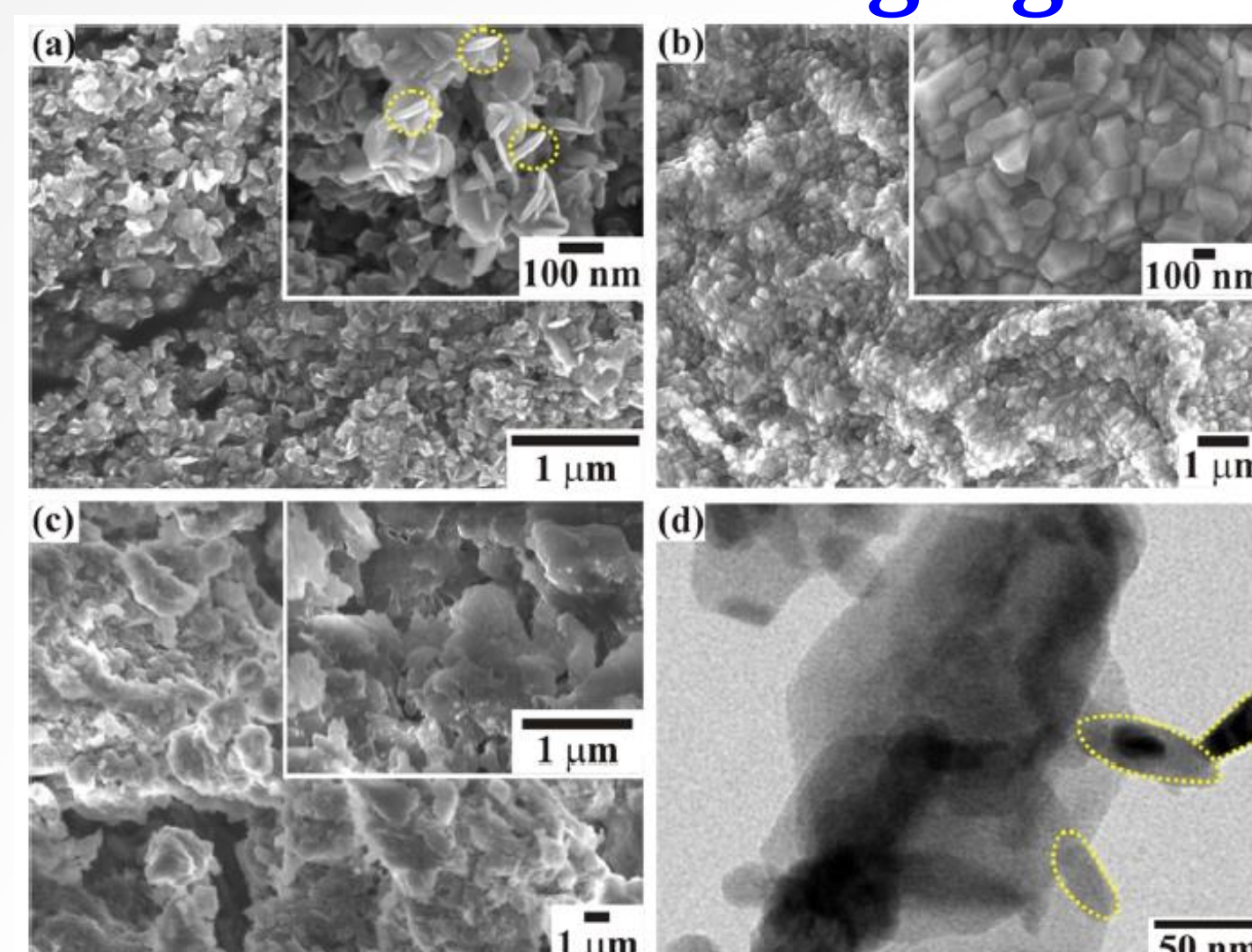
Sodium Alginate–CuS Nanostructures Synthesized at the Gel–Liquid Interface: An Efficient Photocatalyst for Redox Reaction and Water Remediation

Likhi Dhruv,* Deepak K. K. Kori, Apurba K. Das

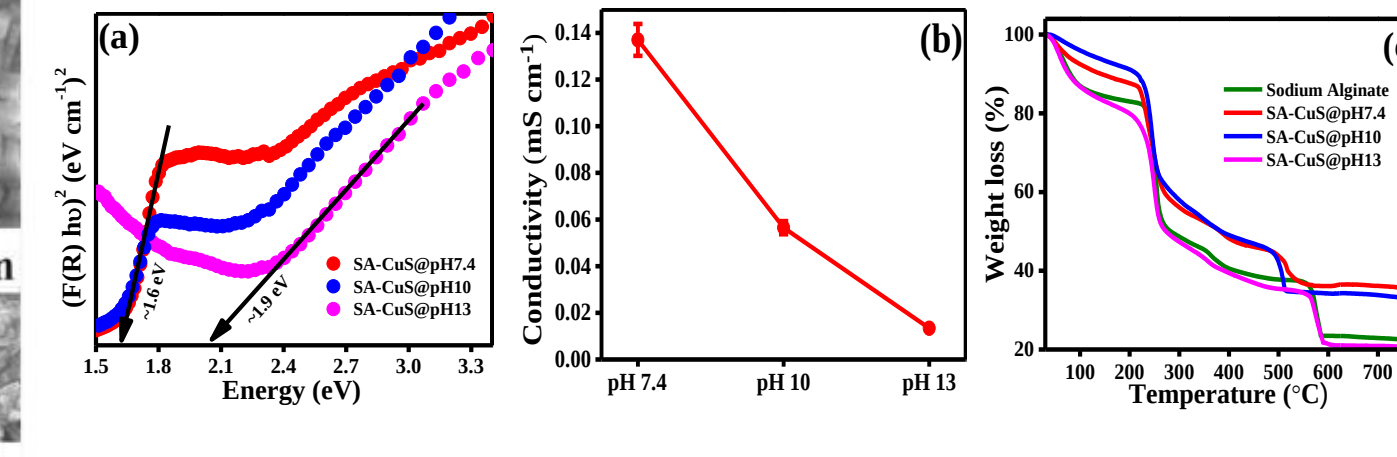
Department of Chemistry, Indian Institute of Technology Indore, Indore 453552, India,

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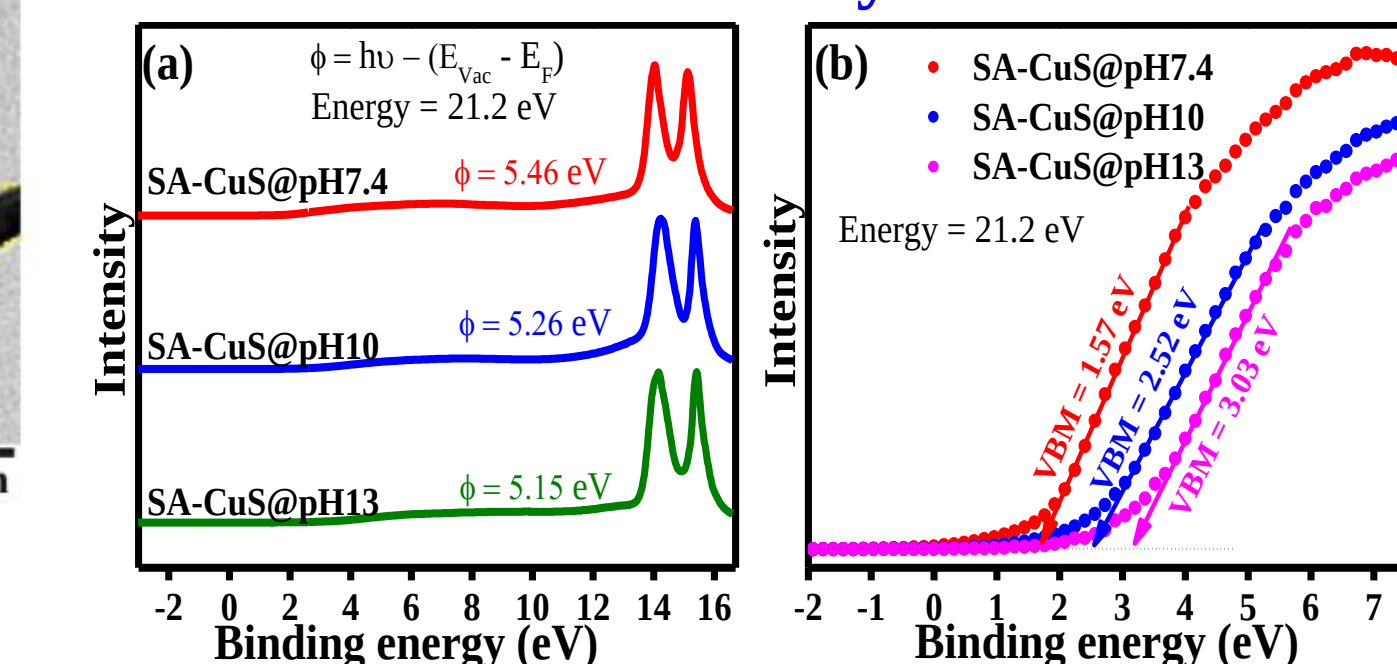
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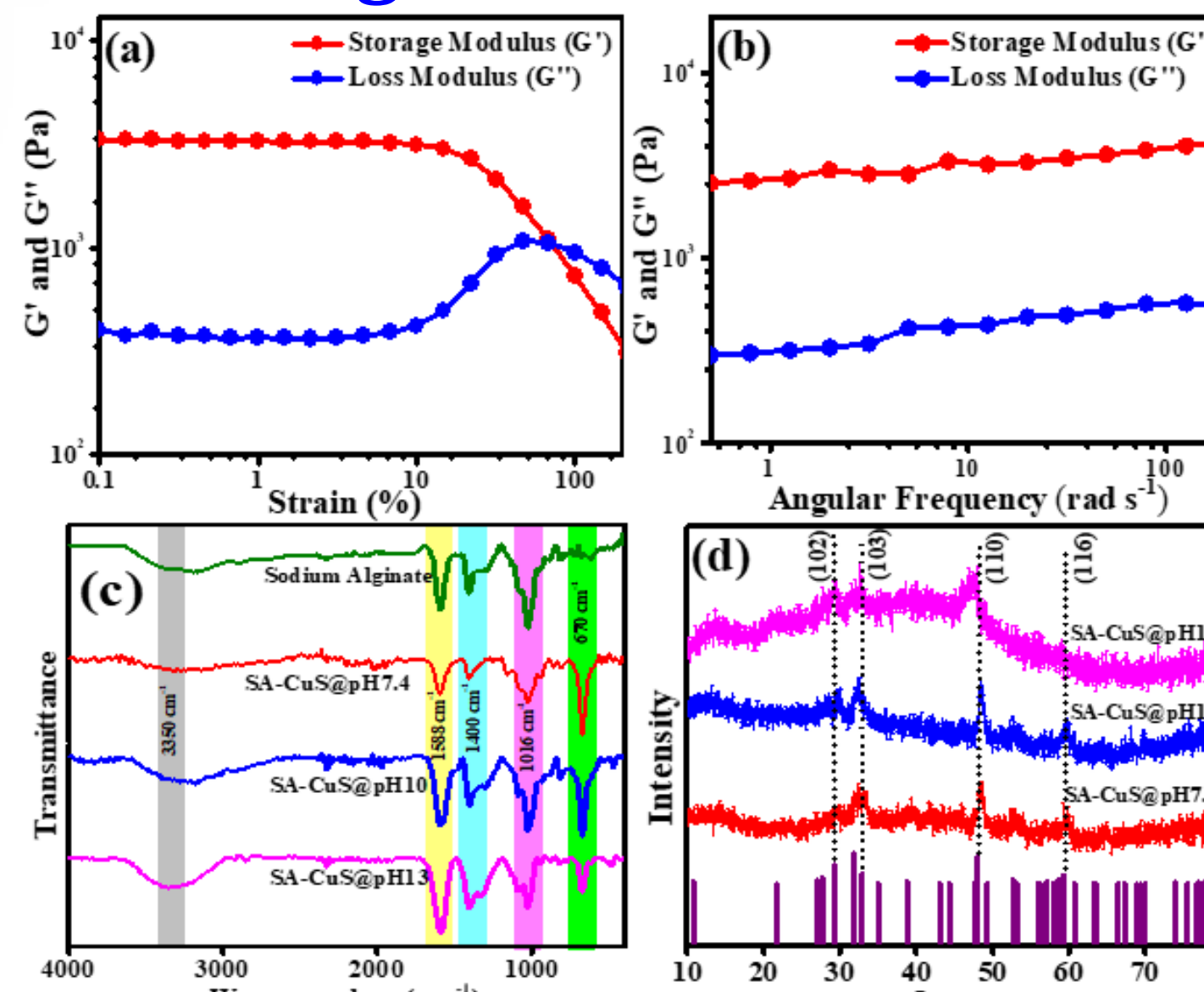
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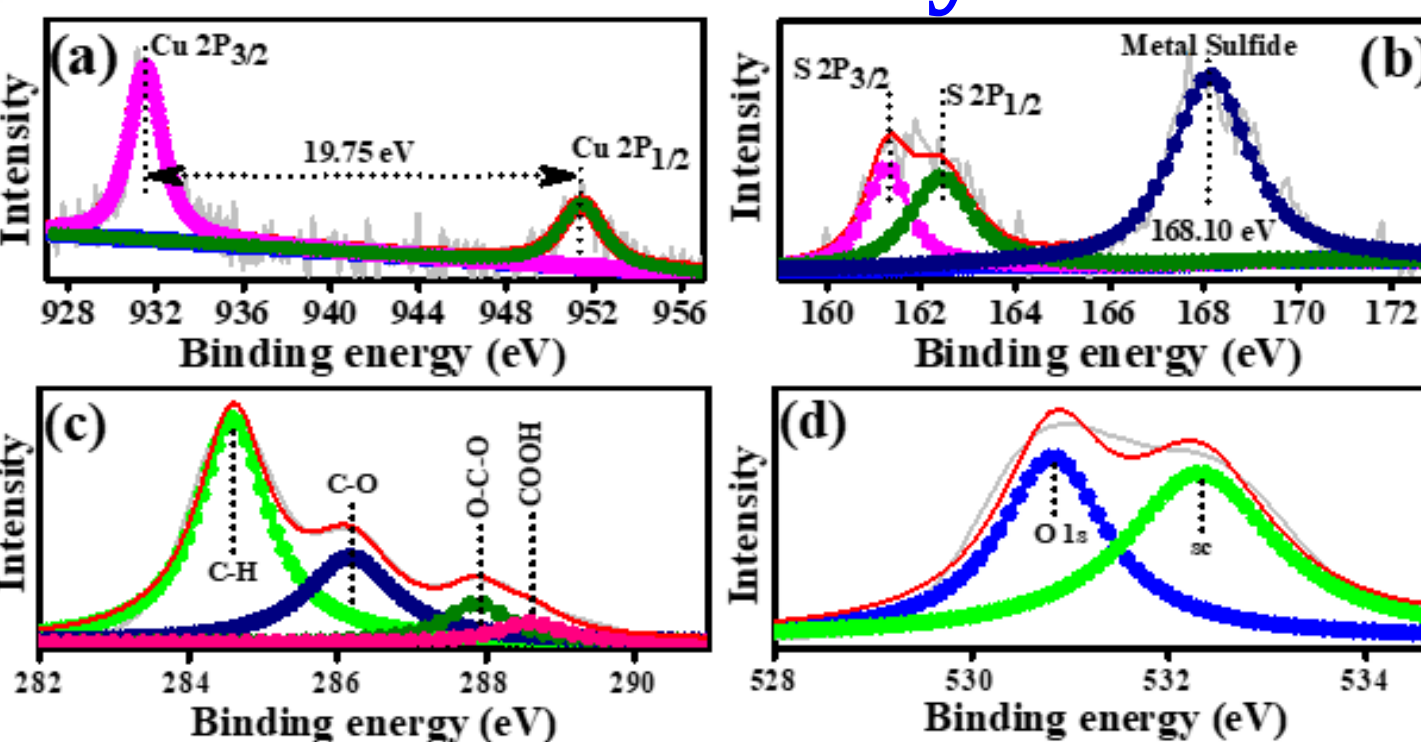
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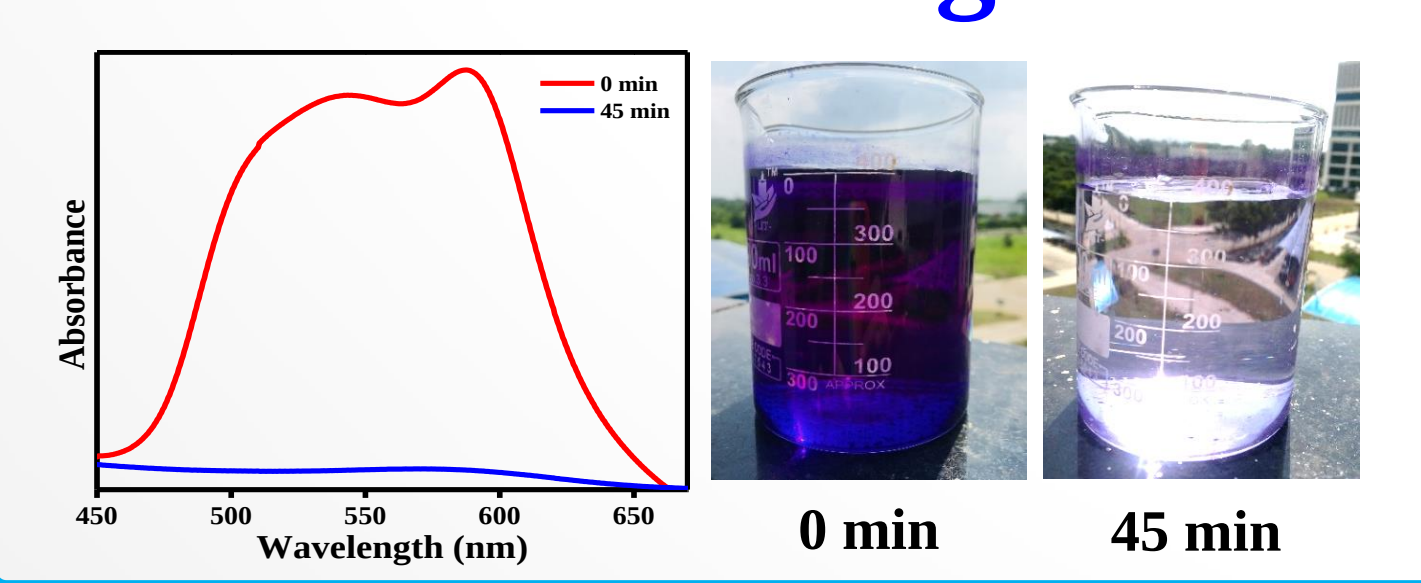
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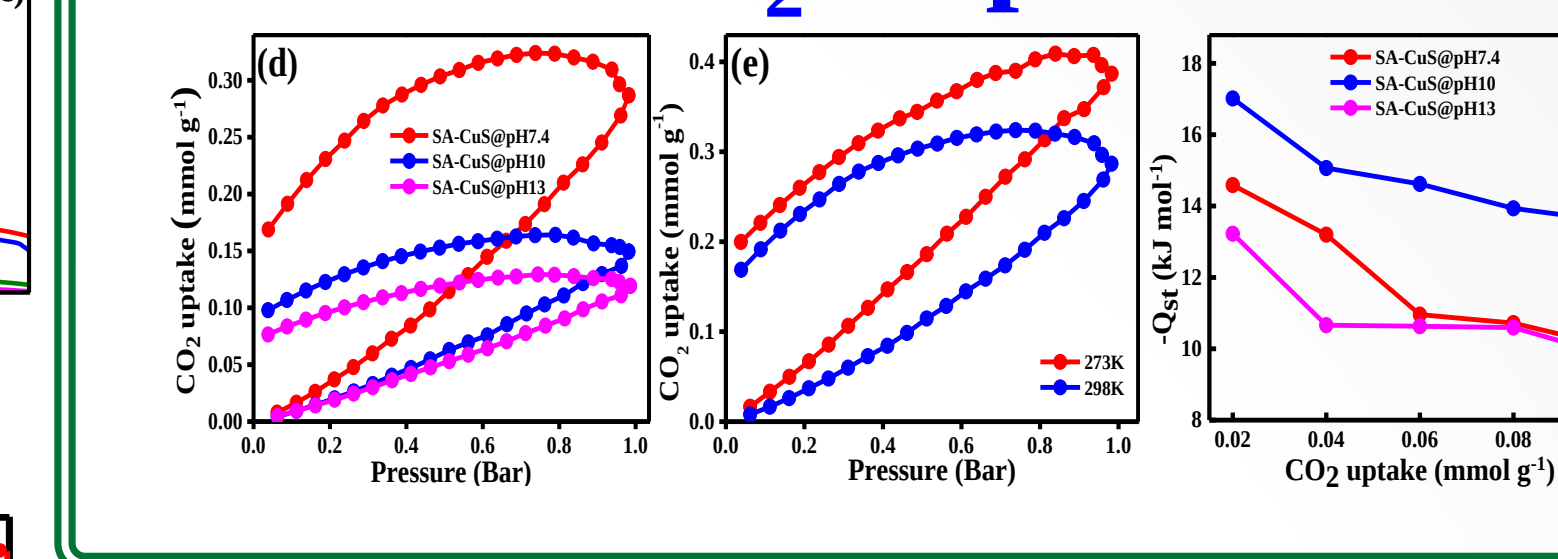
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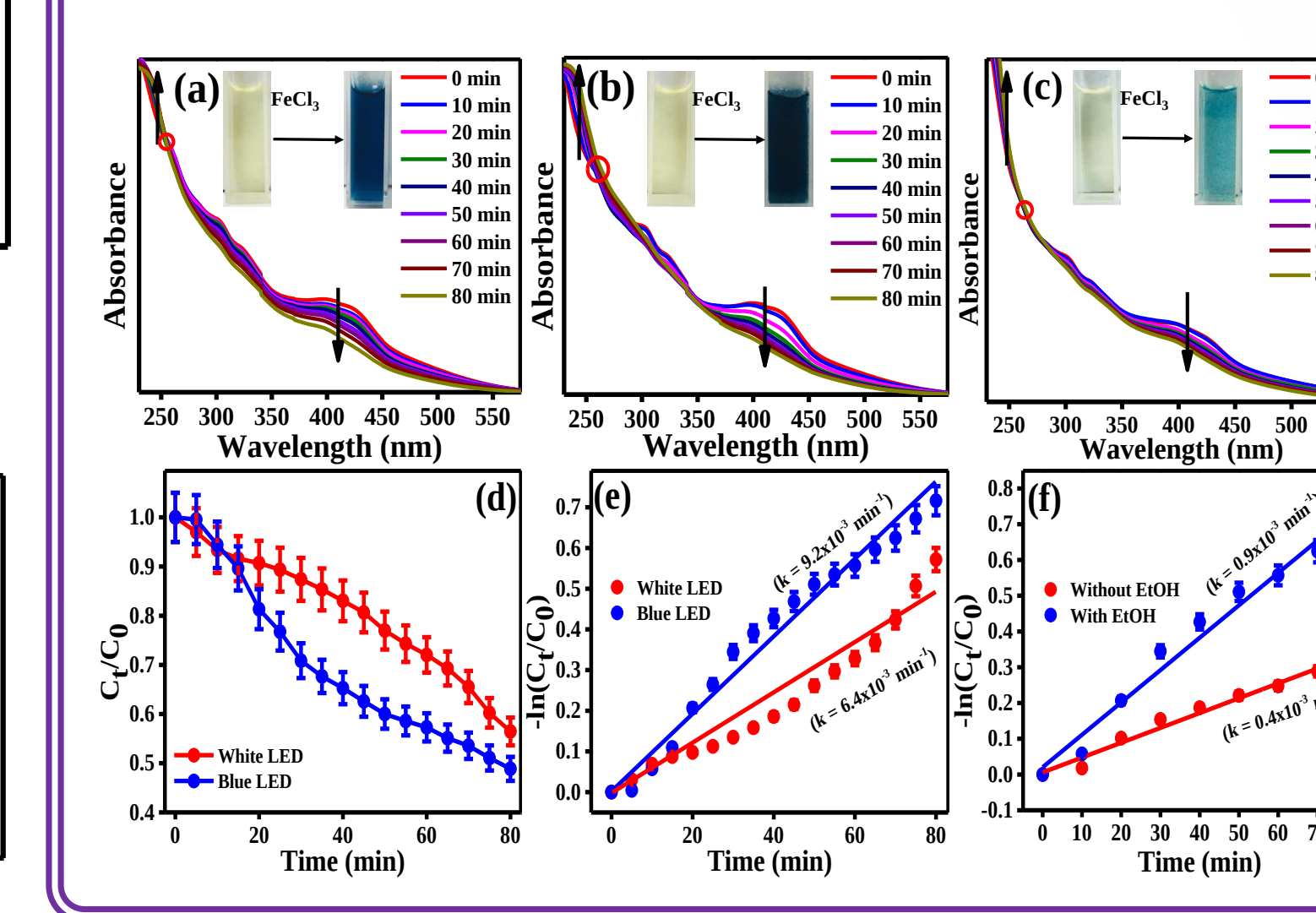
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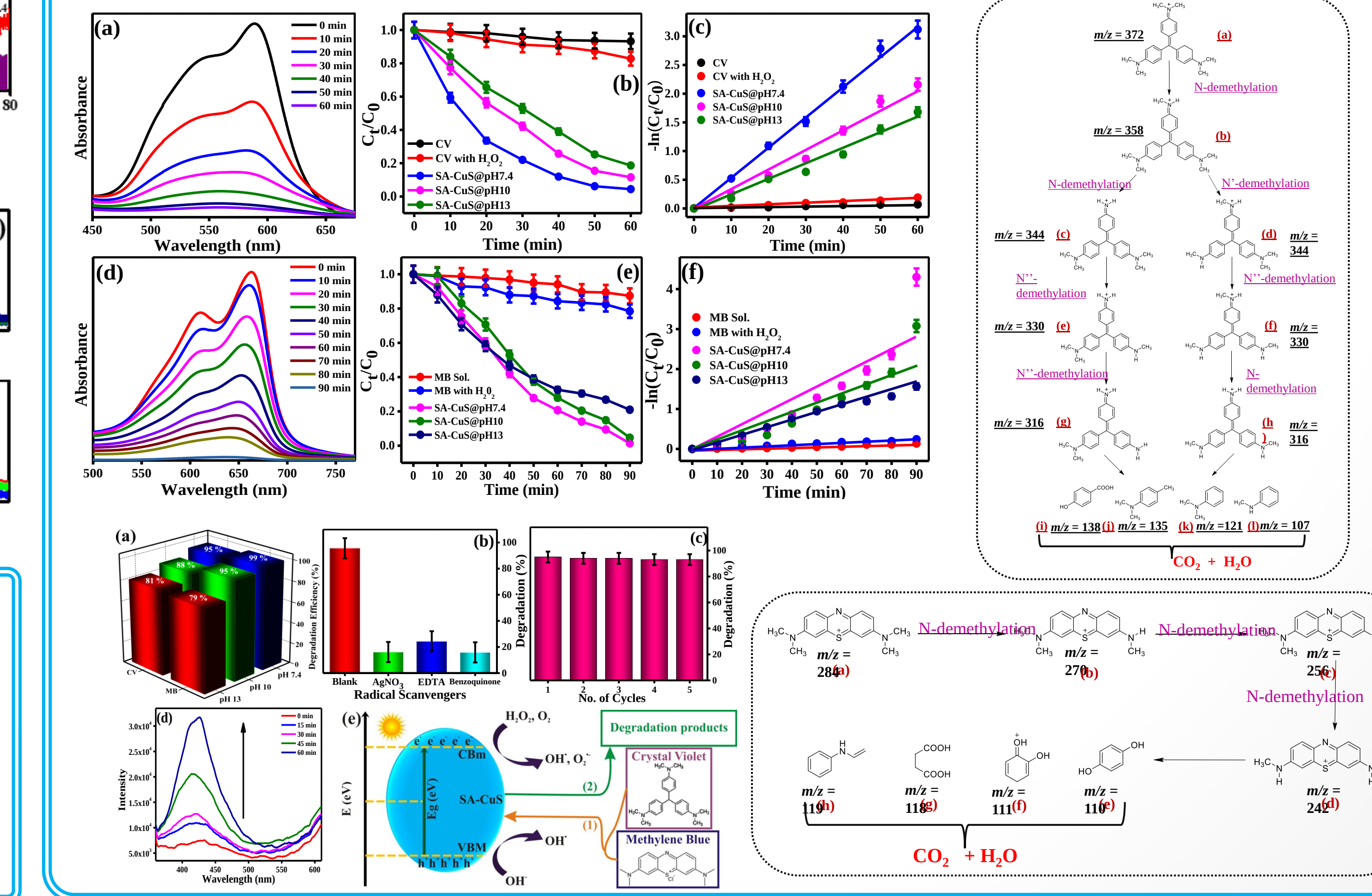
CO₂ Capture



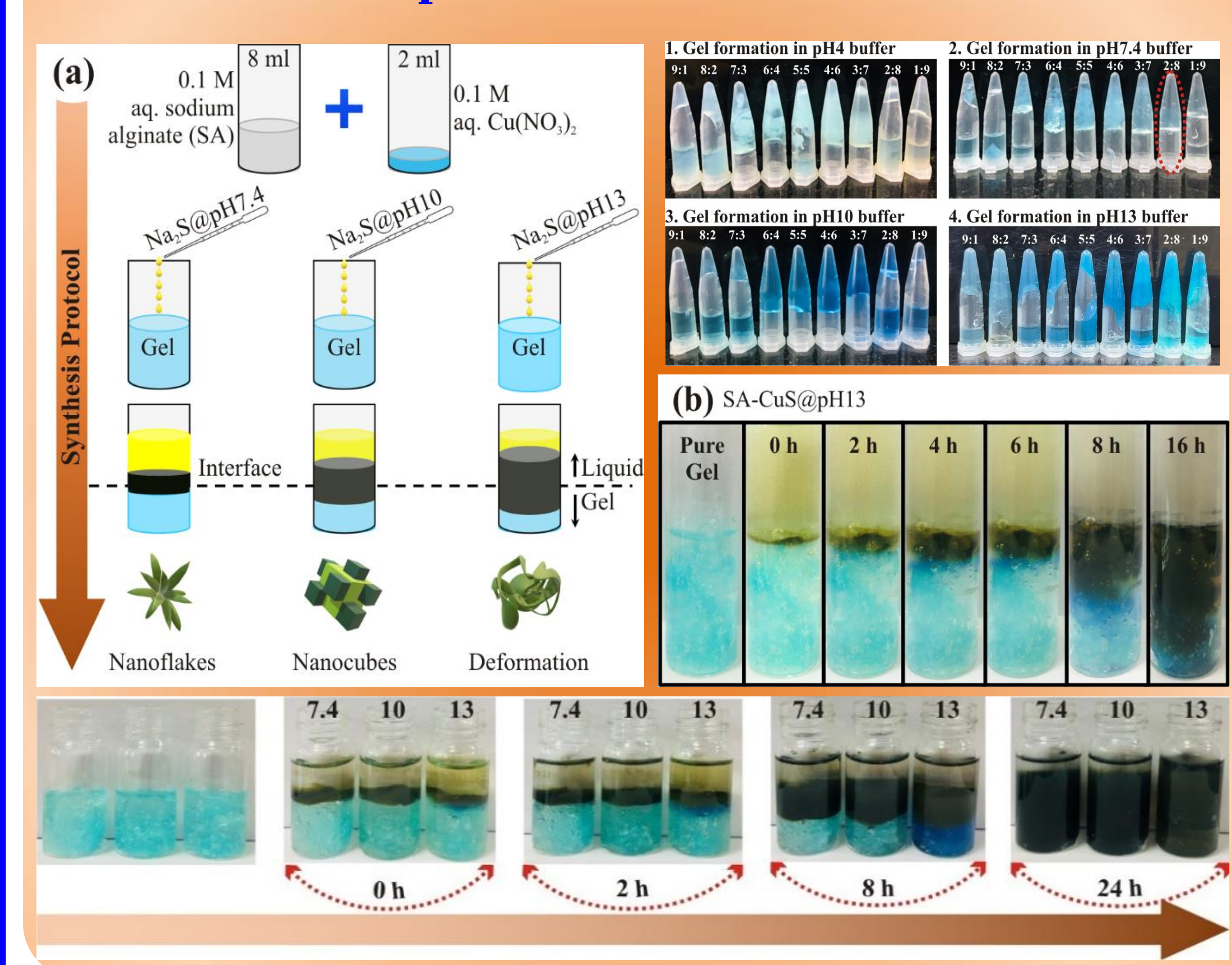
Redox Reactions



Water Remediation



Experimental Procedure



Conclusions

- The gel-liquid interface was used to synthesize environmentally benign sodium alginate–CuS nanostructures.
- The morphology of CuS nanostructures was studied depending on the driving force of the reaction, regulated by controlling the pH of the reaction.
- The SA-CuS nanostructures showed good thermal stability up to ~200 °C and physisorbed greenhouse CO₂ as determined by the Clausius–Clapeyron equation.
- SA-CuS@pH7.4, when employed as the photocatalyst, showed higher degradation of toxic MB and CV dye molecules than SA-CuS@pH10 and SA-CuS@pH13 due to a low band gap, and high conductivity.
- Owing to the better photocatalytic performance, SA-CuS@pH7.4 was investigated for the photoredox reaction during the photoconversion from ferricyanide to ferrocyanide. A conversion yield of ~51% was obtained under the illumination of blue light in the presence of ethanol.

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