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A Promising Cellulose Nanofibrials-Cyclophosphazene Assembling System for Emulsion Stabilization and Constructing Porous Materials

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INTRODUCTION & AIM

The immiscible water-oil interface offers a promising platform for materials construction and functionalization, which has been a major focus of chemical science and engineering. Cellulose nanofibrils (CNF) is a green biomass nanomaterial with high aspect ratio and interfacial activity. Pickering emulsions stabilized by CNF have recently drawn attractive attention. Compared to molecule surfactants, some solid particles like cellulose nanomaterials, are more in demand for emulsification because of an outstanding stability. Meanwhile, CNF can be dispersed into the matrix to form polymer composites, playing an important role in emulsion stability and interfacial properties. Cyclophosphazene is a series of materials with high thermal stability, low toxicity, good flammability resistance, and tuneability in chemical structures, which performed excellent properties in widely fields such as aerospace materials, energy storage and bioengineering.

METHOD

By using electrostatic interactions between cellulose nanofibrils (CNF) and animo-substituted cyclophosphazene (ACP), the formation and assembly of novel CNF-ACP-based supramolecular at water-toluene interface is demonstrated.

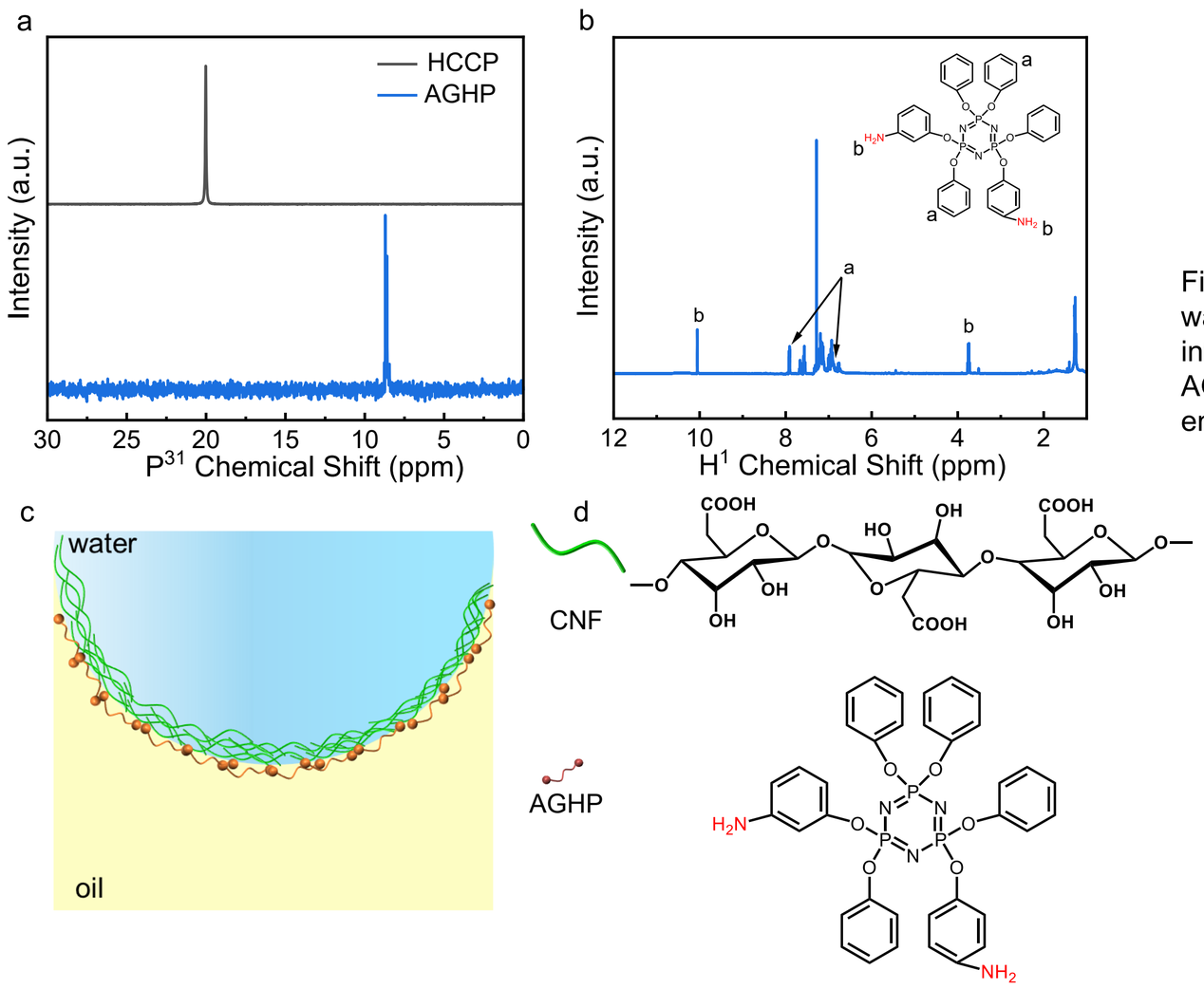

Figure 1. (a) ^{31}P NMR, (b) ^{1}H NMR spectra of AGHP. (c) Schematic diagram of CNF-AGHP assembly at interface. (d) Chemical structure of CNF and AGHP.

RESULTS & DISCUSSION

The packing density of supramolecular at the interface can be tumbled by tuning pH value and concentrations of ligands. The utilization of CNF-ACP as building blocks enables the fabrication of interfacial assemblies including 2D Janus films. With CNF-ACP as emulsifiers, stable O/W emulsions can be prepared in one step homogenization. Moreover, when used emulsion as templates, porous materials can be synthesized by polymerizing the water phase and freeze-drying strategy.

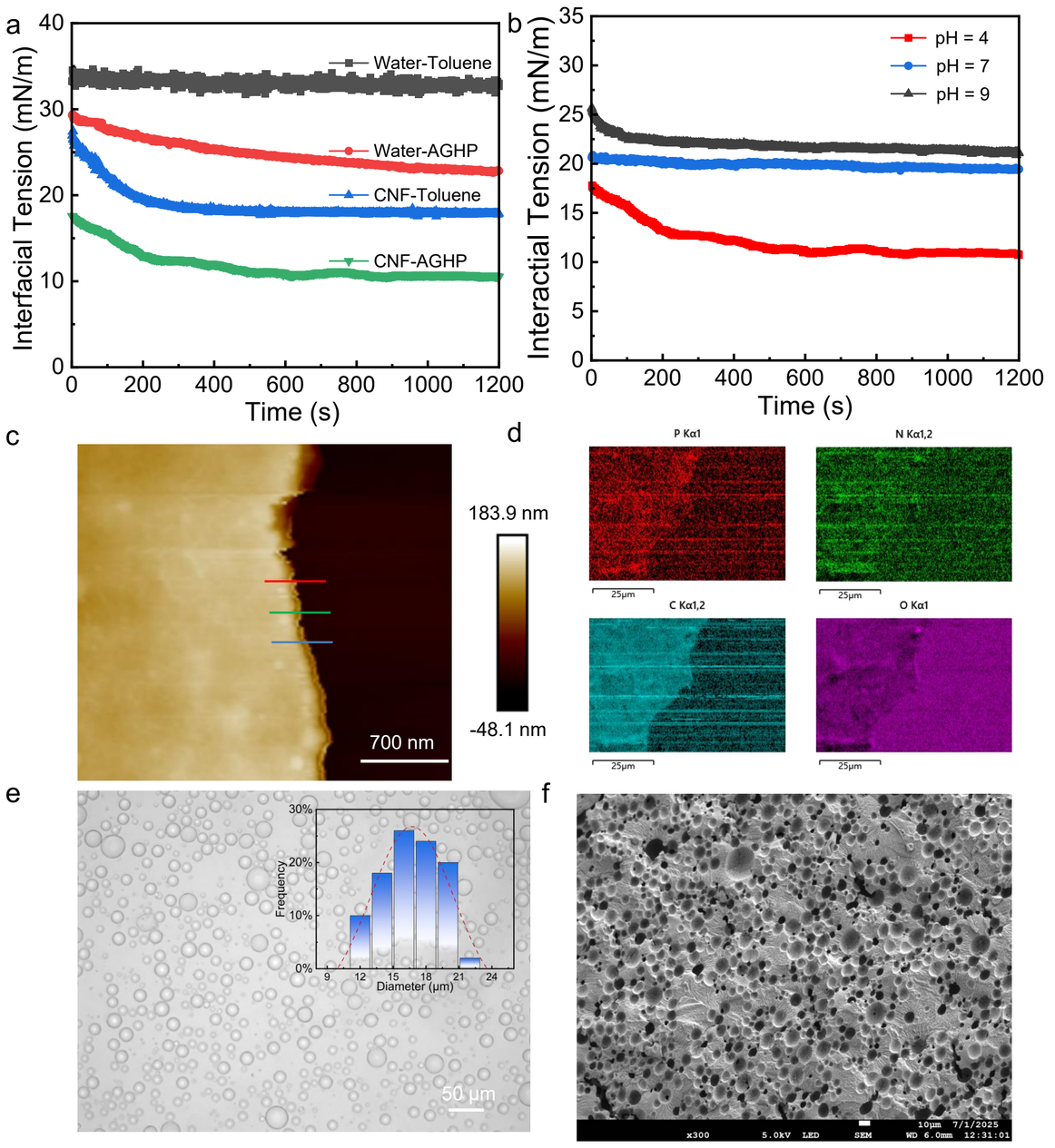

Figure 2. (a) Time evolution of interfacial tensions for water/toluene, CNF@water/toluene, water/AGHP@toluene, and CNF@water/AGHP@toluene systems. (b) Time evolution of interfacial tensions of CNF@water/AGHP@toluene at different pH. (c) AFM image of CNF-AGHP film. (d) EDS elemental mapping of 2D film. (e) optical images of CNF-AGHP stabilized emulsion. (f) SEM images of porous materials.

CONCLUSION

All these results open a new avenue for stabilizing all-liquid systems and constructing porous materials, numerous applications in the field of adsorption and electrochemical energy storage can be achieved.

FUTURE WORK / REFERENCES

Future work: Electrochemical performance evaluation and so forth.

References:
[1] Wang Y K. Amphiphilic Polyphosphazene for Fluorocarbon Emulsion Stabilization[J]. Small, 2024, 20, 2312275.
[2] Qiu M N. Heteroatom-doped ultrahigh specific area carbons from hybrid polymers with promising capacitive performance[J]. J Power Sources, 2020, 478, 228761.