

Supporting Information

Solvent-free all-bio-based underwater adhesive featuring degradability and closed-loop recycling

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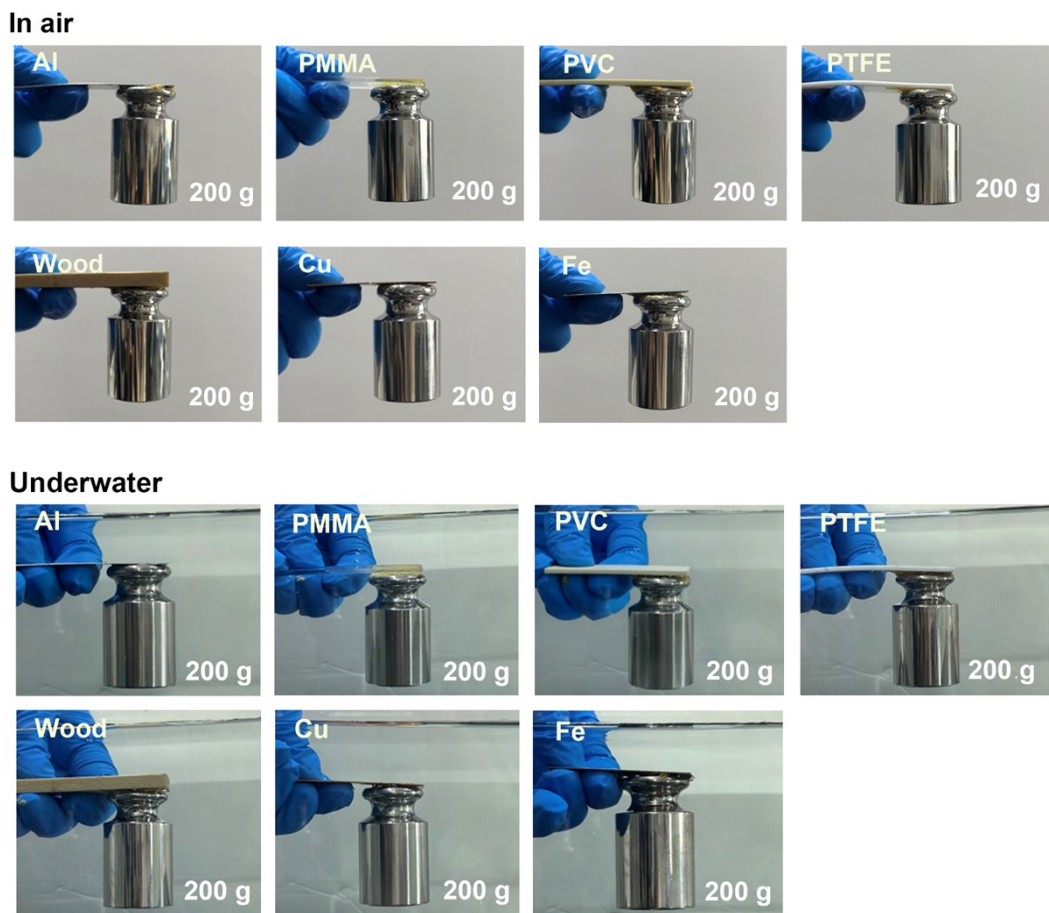


Fig. S1. The adhesion exhibition of PTA-Zein adhesive on different substrates in air and underwater.

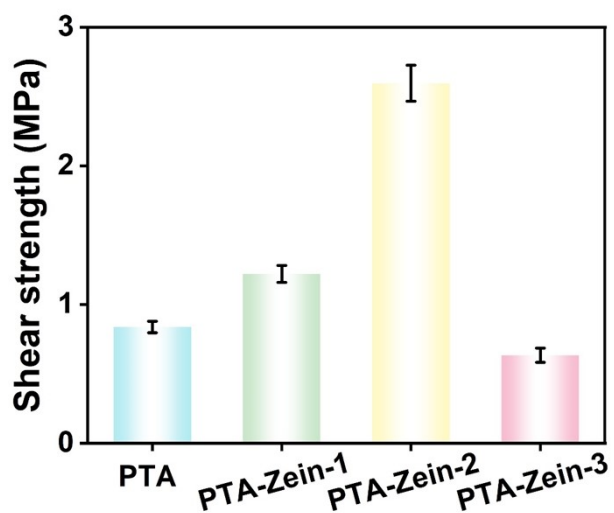


Fig. S2. The shear adhesion strength of PTA-Zein adhesive with different ratios of zein to TA.

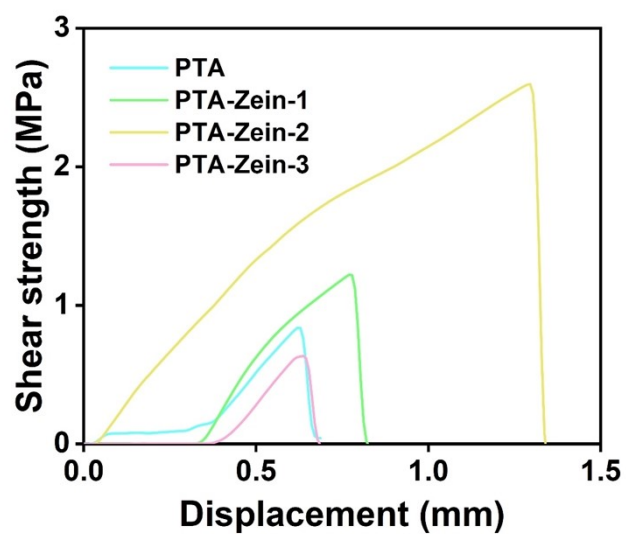


Fig. S3. The shear adhesion strength curves of PTA-Zein adhesive with different ratios of zein to TA.

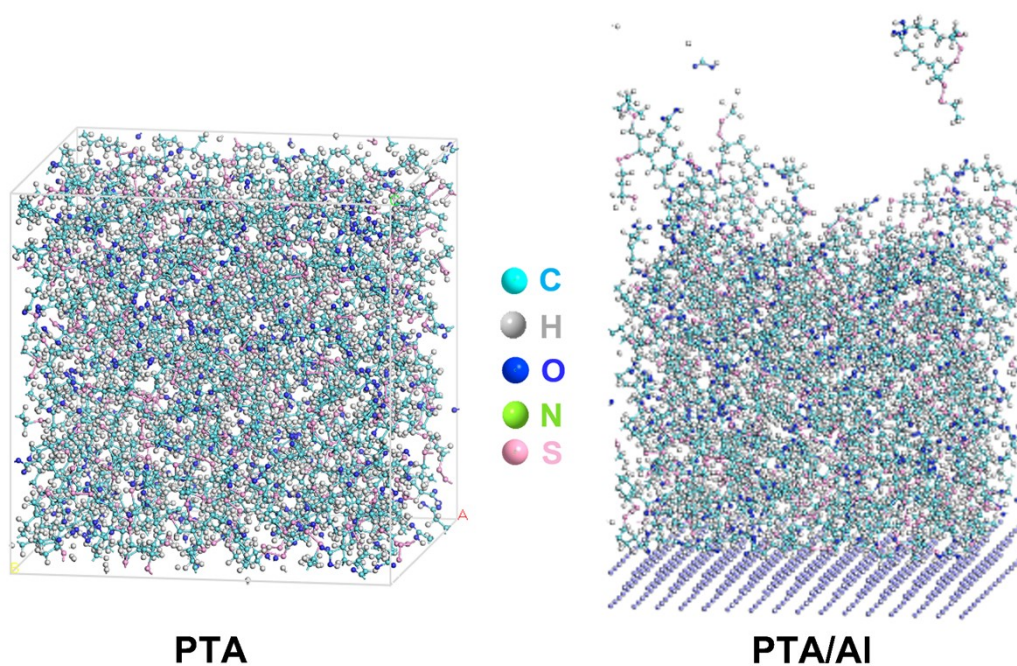


Fig. S4. The PTA adhesive system and its interfacial bonding on Al sheets at 298 K.

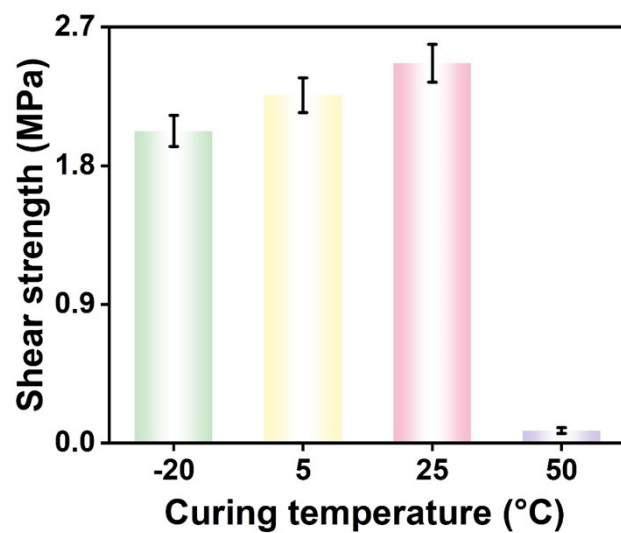


Fig. S5. The shear adhesion strength of PTA-Zein adhesive at different curing temperatures.

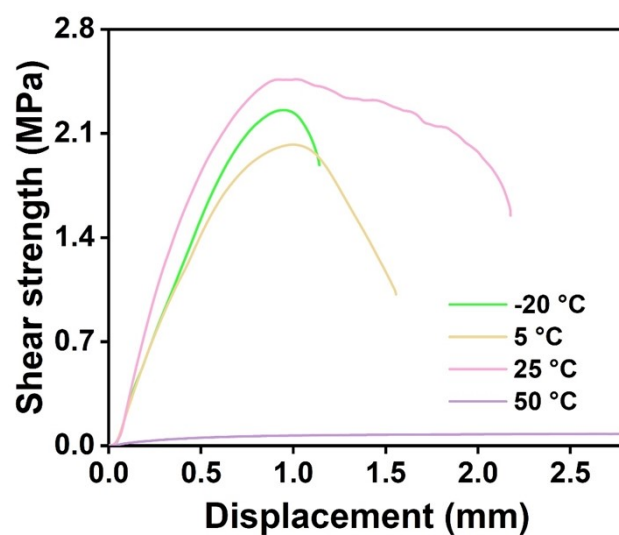


Fig. S6 The shear adhesion strength curves of PTA-Zein adhesive at different curing temperatures.

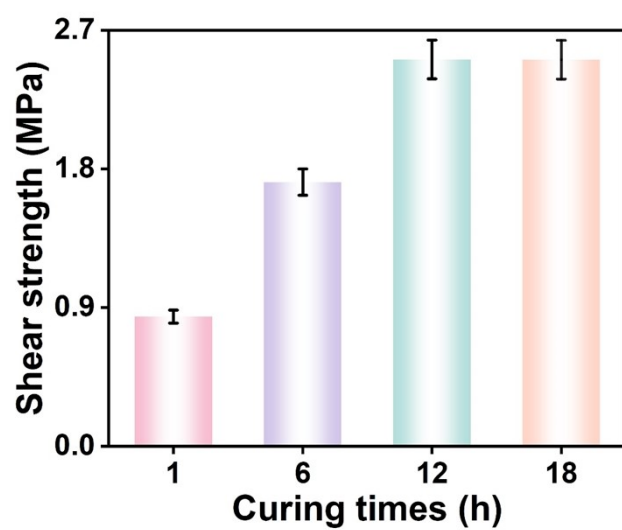


Fig. S7. The shear adhesion strength of PTA-Zein adhesive at different curing times.

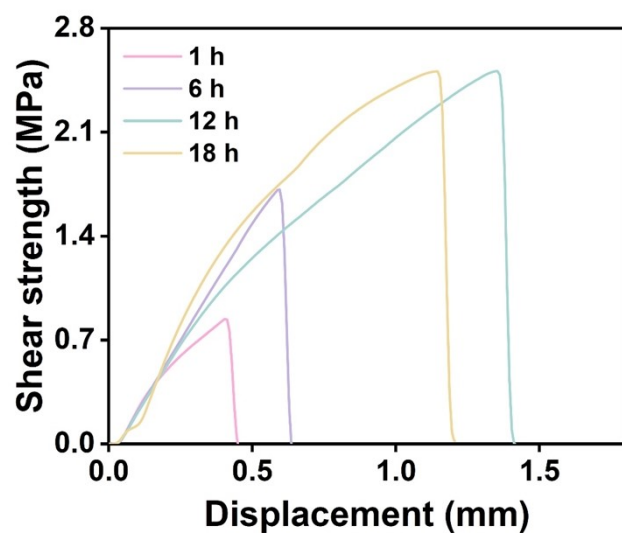


Fig. S8. The shear adhesion strength curves of PTA-Zein adhesive at different curing times.

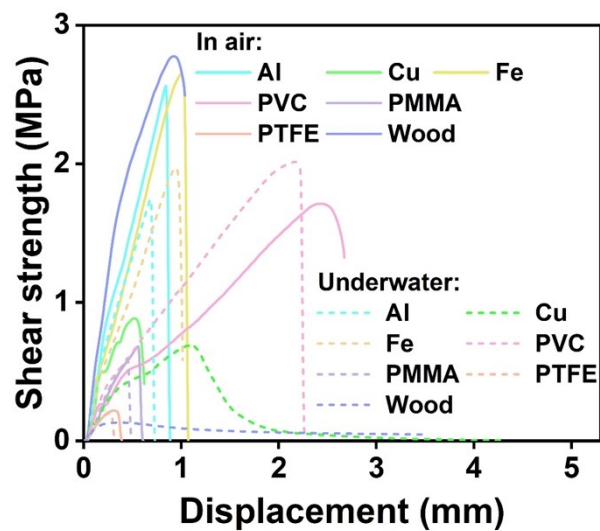


Fig. S9. The shear adhesion strength curves of PTA-Zein adhesive with different substrates in air and underwater.

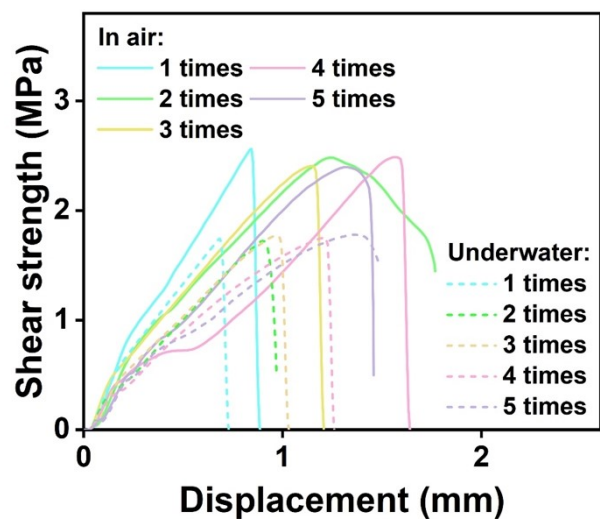


Fig. S10. The shear adhesion strength curves of PTA-Zein adhesive for five times adhesion cycles in air and underwater.

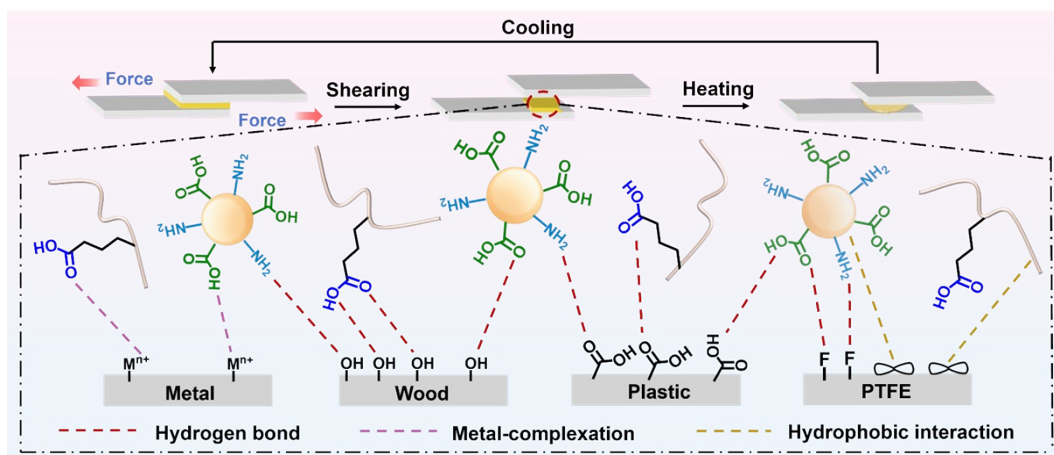


Fig. S11. Hot-melt recycling process and adhesion mechanism of PTA-Zein adhesive.

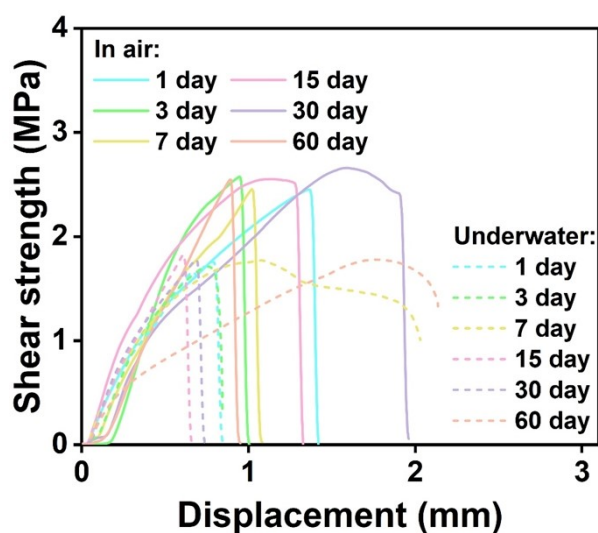


Fig. S12. The shear adhesion strength curves of PTA-Zein adhesive with different storage times in air and underwater.

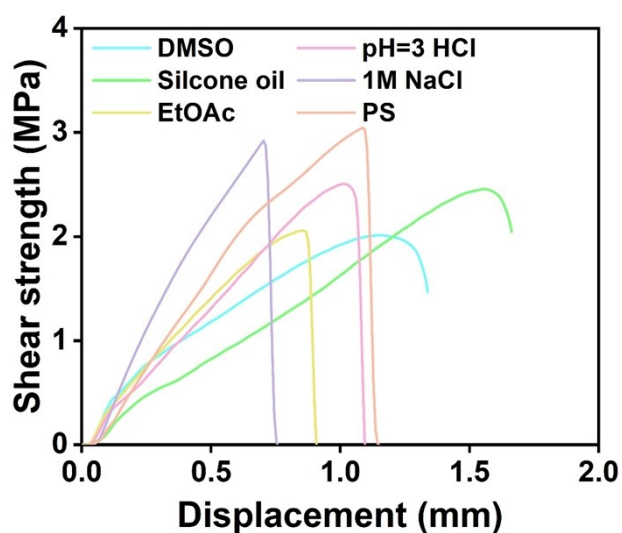


Fig. S13. The shear adhesion strength curves of PTA-Zein adhesive in different

solvents for 2 days.

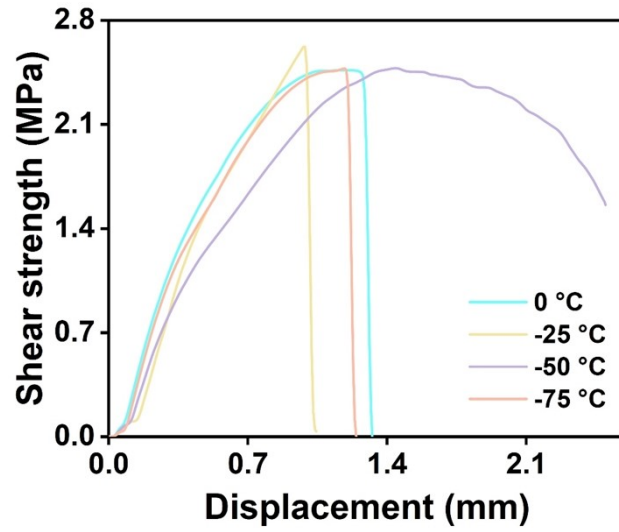


Fig. S14. The shear adhesion strength curves of PTA-Zein adhesive in different low-temperature environments for 2 days.

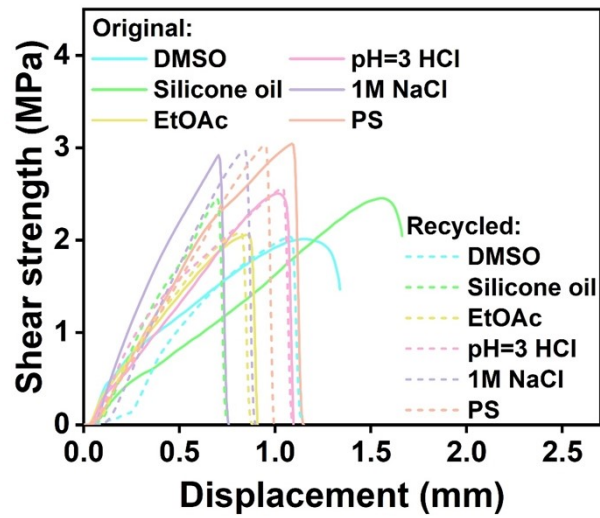


Fig. S15. Comparison of adhesion strength curves in different solvents after immersing for 2 days between the original and recycled PTA-Zein adhesive.

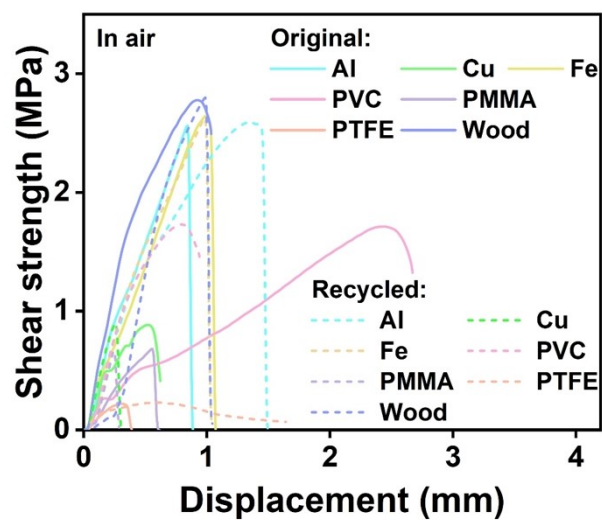


Fig. S16. Comparison of adhesion strength curves on various substrates between the original and recycled PTA-Zein adhesive in air.

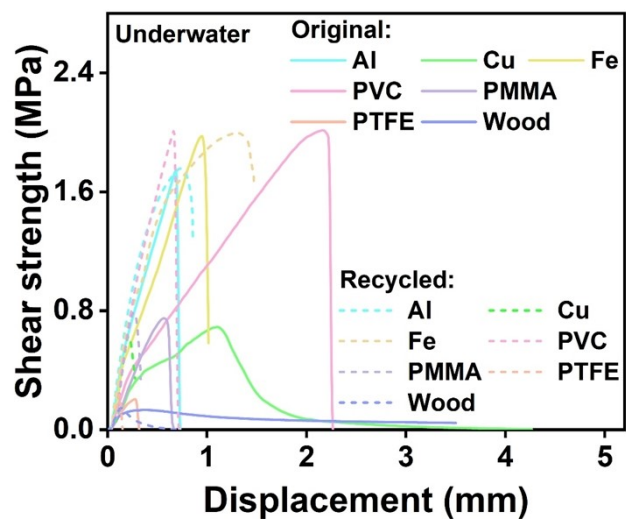


Fig. S17. Comparison of underwater adhesion strength curves on various substrates between the original and recycled PTA-Zein adhesive.

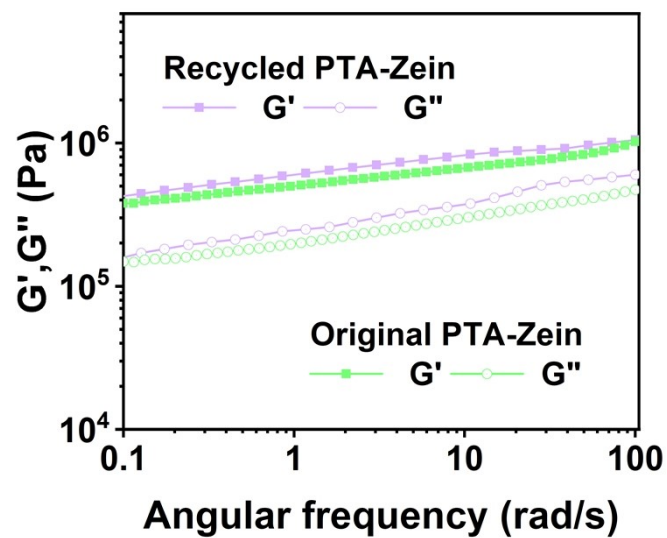


Fig. S18. Frequency dependency of storage and loss modulus of original and recycled PTA-Zein adhesive.

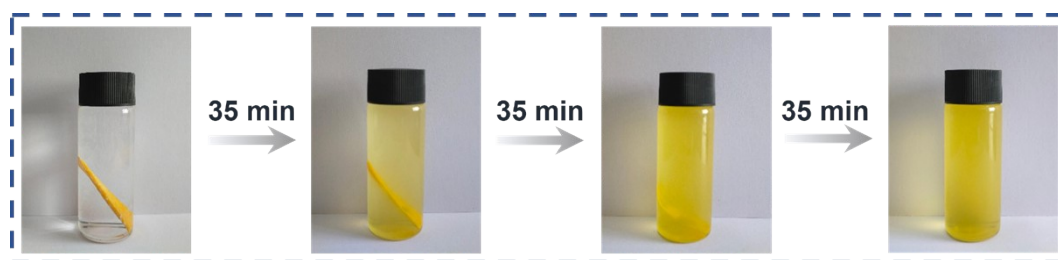


Fig. S19. Degradation of PTA-Zein adhesive in 0.5 M NaOH solution.

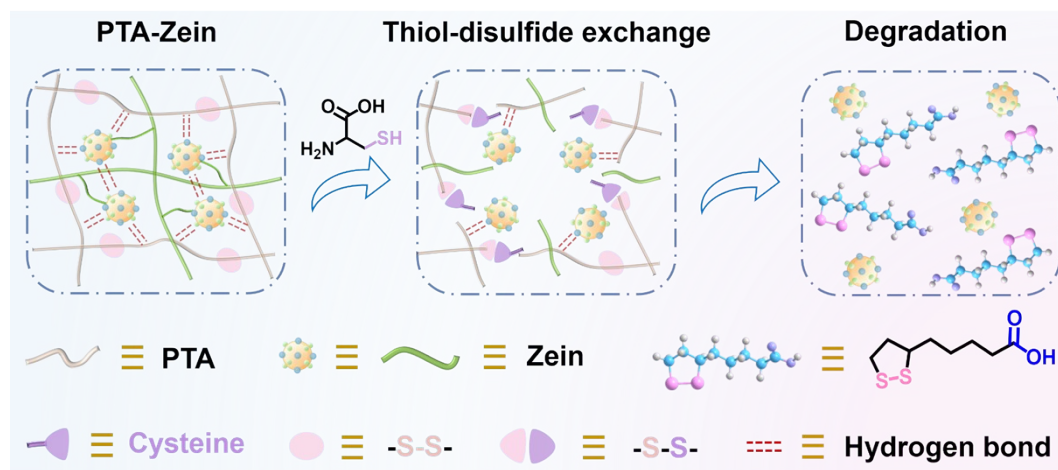


Fig. S20. Degradation mechanism of PTA-Zein adhesive in PBS with 10 mM cysteine solution.

Life Cycle Analysis:

PTA-Zein adhesive synthesis and recycling of TA process:

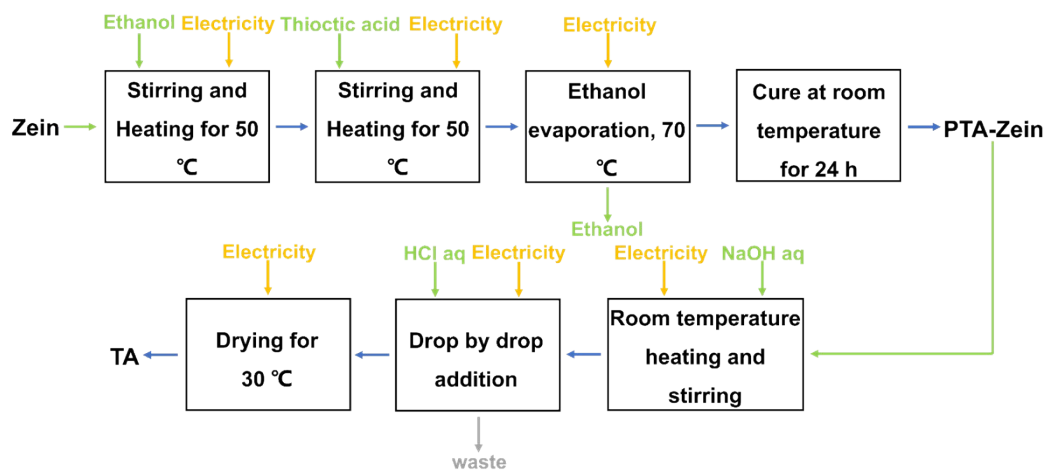


Fig. S21. Flowchart of PTA-Zein adhesive synthesis and TA recycling. Materials are highlighted in green; electricity use is highlighted in yellow; waste materials are highlighted in grey. Boxes contain process within the procedure, blue arrows indicate the next step in the procedure.

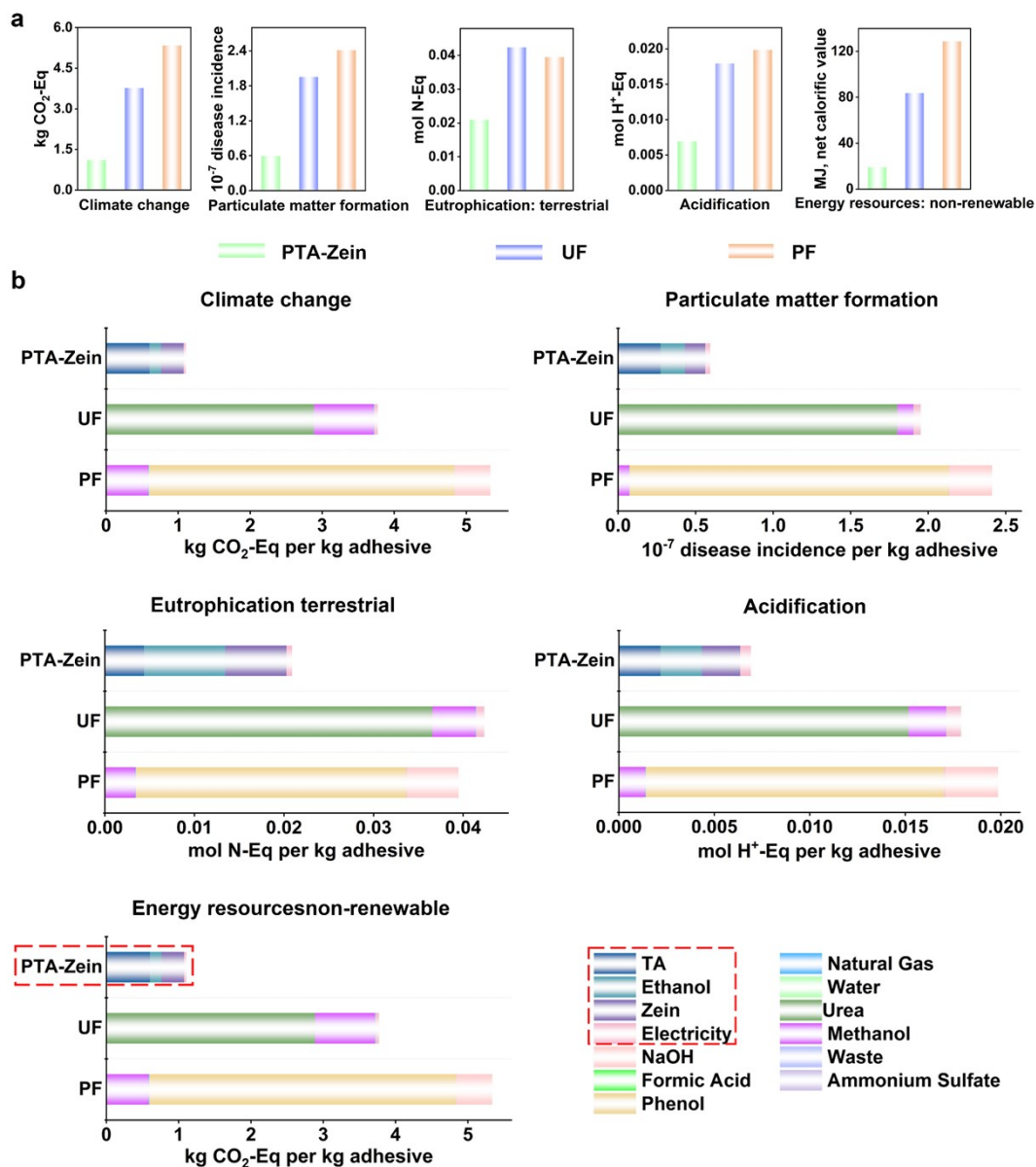


Fig. S22. (a) Environmental impacts of PTA-Zein compared to petroleum-based UF and PF, (b) disaggregated impacts of PTA-Zein, UF, and PF across the five relevant categories.

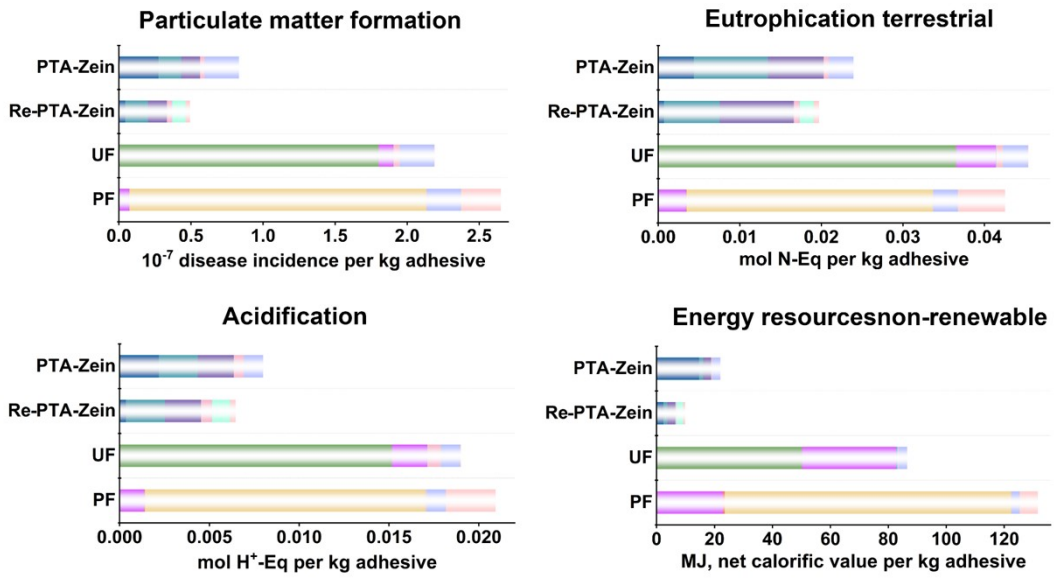


Fig. S23. Disaggregated impacts of PTA-Zein, Re-PTA-Zein, UF, and PF across the four relevant categories.

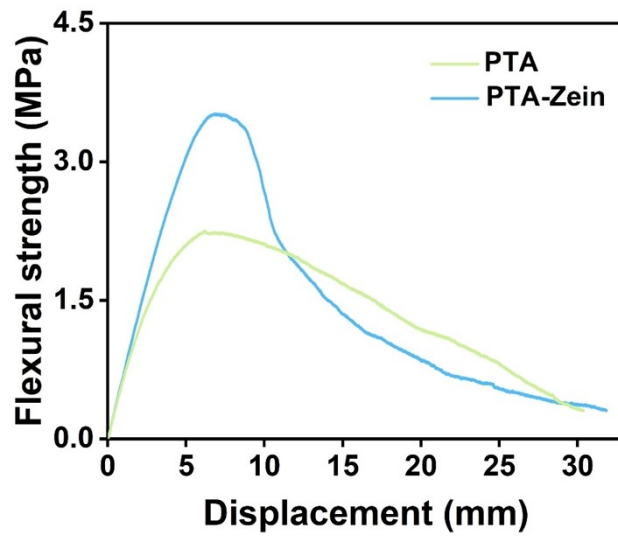


Fig. S24. The flexural strength curves of particleboard bonded with PTA and PTA-Zein adhesives.

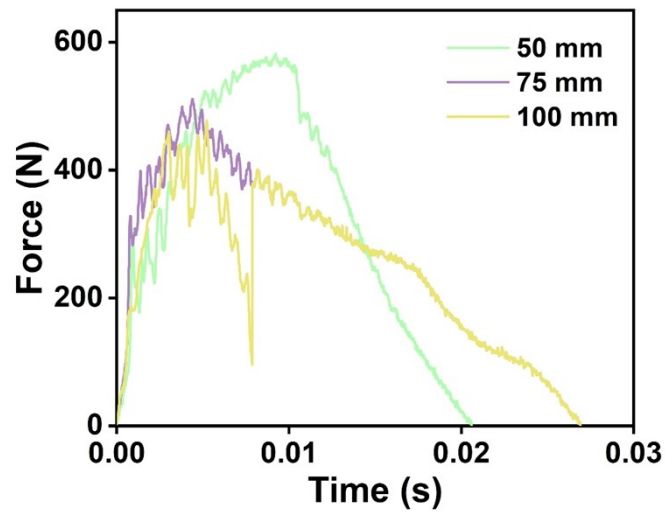


Fig. S25. The reaction force curves of the PTA-Zein adhesive-bonded particleboard under different hammer drop heights.

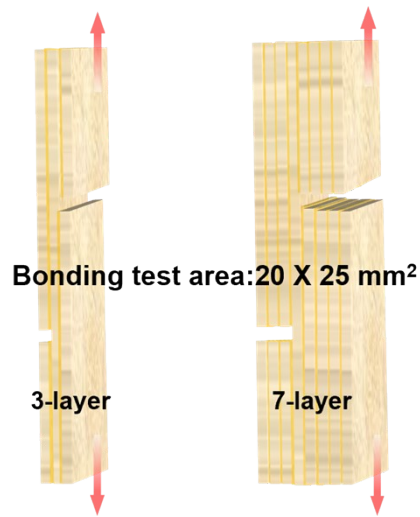


Fig. S26. Photograph of shear strength test specimen from multi-layer plywood.

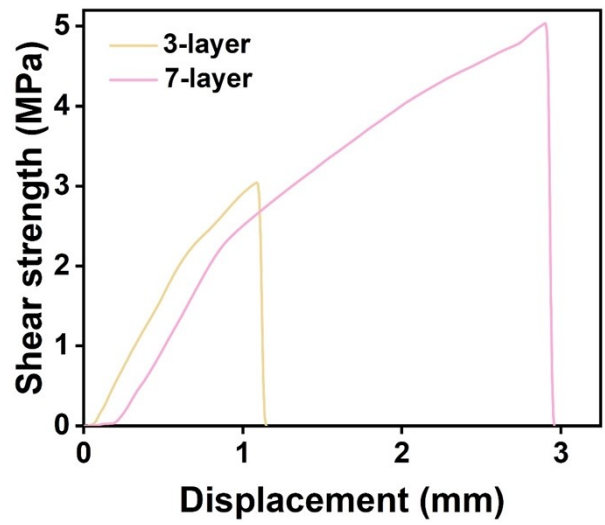


Fig. S27. The shear adhesion strength curves of multi-layer plywood.