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# Bio-Based Flame-Retardant and Smoke-Suppressing Wood Plastic Composites Enabled by Phytic Acid Tyramine Salt

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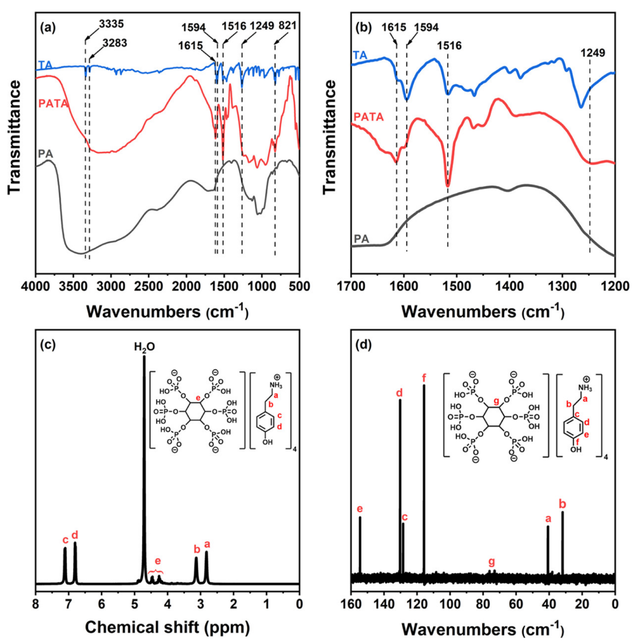
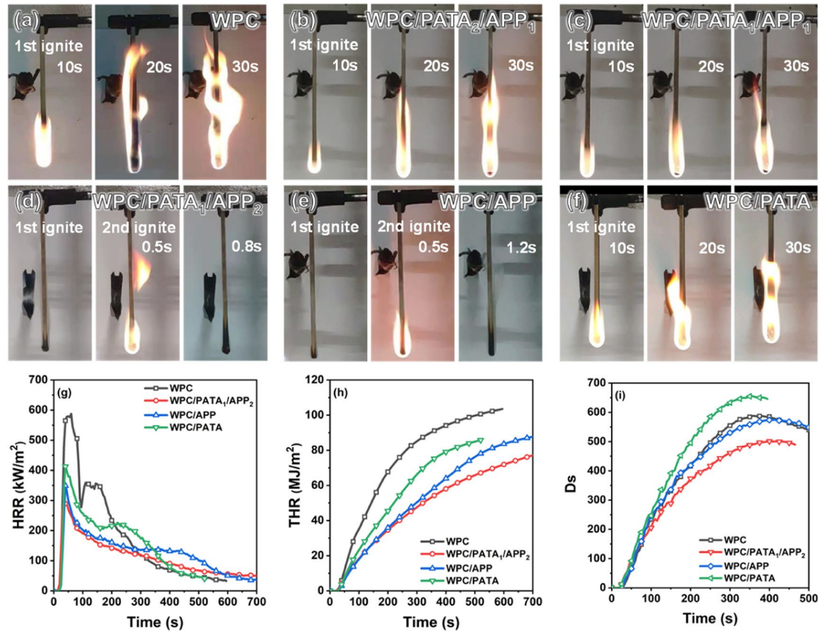
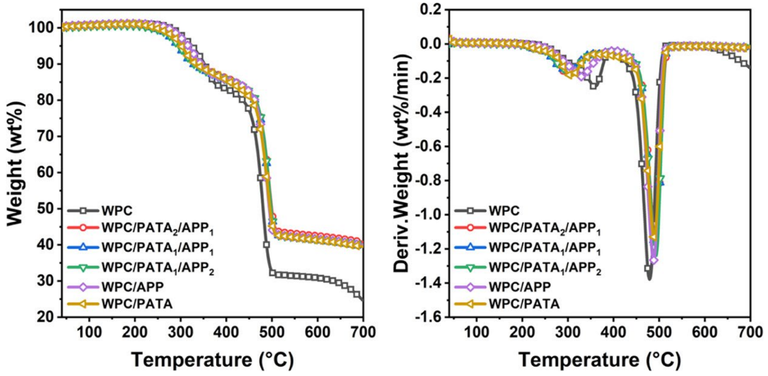
## Abstract

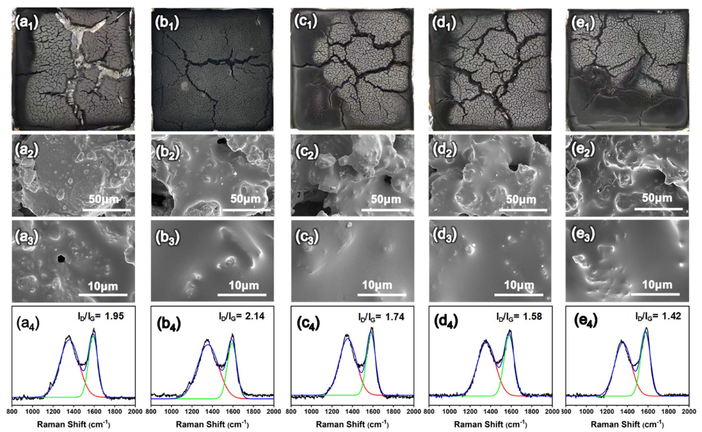
Bio-based chemicals and waste plastic recycling play important parts in the development of a circular economy. Wood-plastic composites (WPCs), composed of recycled plastic and wood-processing residues, offer environmentally friendly alternatives. However, their inherent flammability poses fire hazards. While bio-based flame retardants offer advantages over conventional counterparts, their integration into WPCs remains underexplored. In response, a fully bio-based flame retardant, phytic acid-tyramine salt (PATA), was designed and synthesized using a green approach with deionized water as the solvent. PATA was then combined with ammonium polyphosphate (APP) to synergistically enhance the flame-retardant properties of WPCs. The PATA/APP system demonstrated significant improvements, augmenting flame retardancy and suppressing smoke generation. This system notably increased the limiting oxygen index by 31% and achieved a V-0 rating in vertical combustion tests. Moreover, it reduced the peak heat release rate, total heat release, and maximum smoke density by 49%, 22%, and 15%, respectively. During combustion, the PATA/APP system generated phosphoric acid substances, facilitating the formation of stable char layers containing P-N-C or P-O-C structures from wood flour decomposition. Overall, this study presents an environmentally friendly approach to enhance the flame retardancy of WPCs. By harnessing bio-based materials and recycling principles, the PATA/APP system offers a promising solution to mitigate fire risks associated with WPCs while contributing to the sustainable utilization of resources in the circular economy paradigm.


## Results

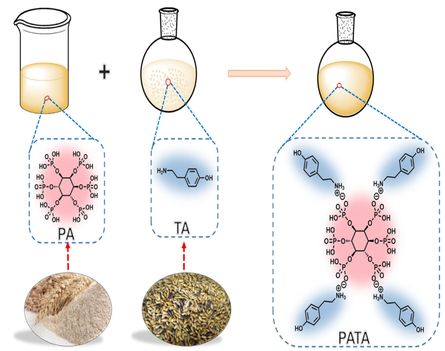



## Synthesis




Synthetic route of bio-based PATA.

## Conclusions

- Enhance flame retardancy of WPC using bio-based PATA and APP.
- Simple, eco-friendly preparation of PATA incorporated with APP into WPC.
- PATA/APP combination shows improved flame retardancy, reduced heat release, and smoke suppression in WPC. Char formation facilitated by PATA enhances the barrier effect.
- The study offers an eco-friendly approach for WPC flame retardancy, highlighting the synergistic benefits of the PATA/APP system in generating a stable char layer.


## Acknowledgments

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## Reference


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