

Novel Eutectic Thermal Energy Storage Materials

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Combating the effects of anthropogenic climate change requires a broad scope of solutions. For instance, the electricity and heating sector is known to produce 39% of global CO₂ emissions¹, as such, sustainable means of producing and storing heat and electrical energy are essential to conserving Earth's climate and resources.

Thermal energy storage materials (TES) are one such answer – indeed materials that are capable of storing thermal heat in the temperature range of 100-220 °C are compatible storage solutions for renewables like solar and wind using devices like Carnot Battery.² Recently, the novel trimodal TES system of boric acid and succinic acid demonstrated the high magnitudes of long-term energy storage that can be achieved.² It is critical to the development of other sustainable TES with high energy density that a comprehensive understanding of systems capable of sensible, latent and thermochemical energy storage methods exists. Thus far, the hydrogen bonding capacity of boric acid and succinic acid is hypothesised to be responsible for the reversible thermochemical storage mechanism (see Figure 1.). In an effort to better understand this phenomenon and the compatibility of other materials, chemicals ranging from amino acids to commercially available salts were tested for eutectic compositions with boric acid. From this investigation, it was discovered that another promising material was able to yield a ΔH_f of $293 \pm 5\%$ J/g and a T_m of 142 ± 1 °C (Figure 2).

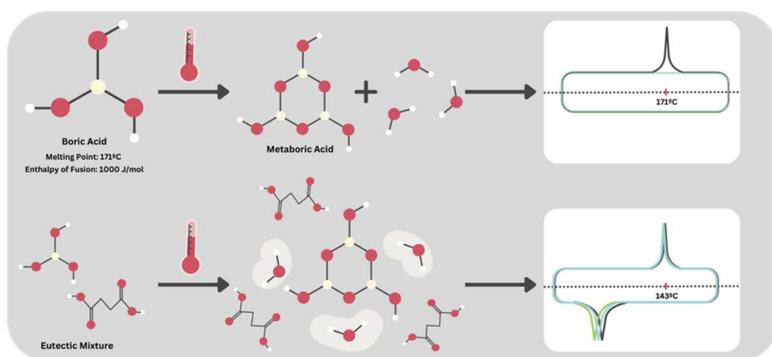


Figure 2. A visualisation of the hydrogen bonding theory posited by Saher (2024), where by the dehydration of boric acid is made reversible by the trapping of water molecules.

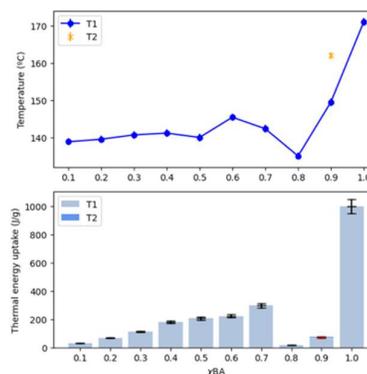


Figure 1. Graphical representation of the new eutectic mixture with boric acid, shown to melt at 142.4 °C with approximately 300 J/g of enthalpy.

References

1. Arce, P., *Appl. Energy*, 2011, **88**(8),

2764–2774

2. Saher, S., *Nature*, 2024, **636**, 622–626



Laura commenced her PhD candidature at Monash University's School of Chemistry in 2025 under the supervision of Dr. Karolina Matuszek. Her Honours thesis entitled 'Investigation of Sustainable Phase Change Materials for the Storage of Renewable Energy' completed in 2024 under Dr. Matuszek's supervision serves as a basis for her PhD research.