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Stabilization of phase change materials for thermal storage applications

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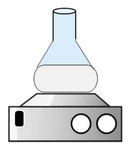
INTRODUCTION

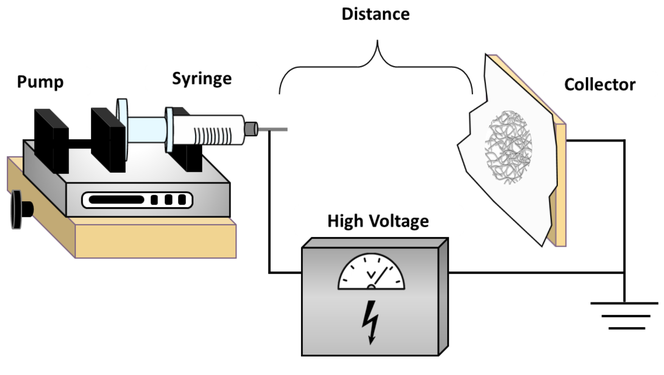
- Phase change materials (PCMs) are compounds that can absorb and release large amounts of thermal energy by taking advantage of their phase change.
- Among these, hydrated salts are particularly interesting due to their high energy density, mainly used in thermal accumulation, being able to absorb heat and release it when necessary [1].
- However, despite their numerous advantages, hydrated salts present the problem of deliquescence, which limits their applications.
- Currently, the development of form-stable phase change materials is pursued, being extremely versatile and suitable for a wide range of industrial and commercial applications, also promoting a more efficient use of energy and contributing to environmental sustainability [2].
- In this study, in order to increase PCMs stability, micro-structured materials are proposed, using the electrospinning technique [3].

EXPERIMENTAL

Hydrated salts

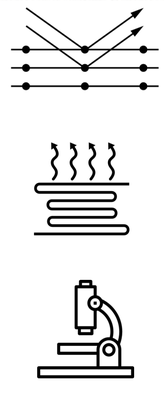
Polymers


Hydrated salt
&
Polymeric solution

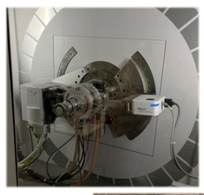


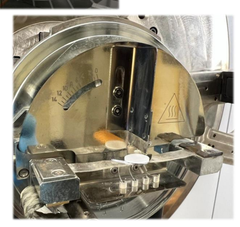
Electrospinning

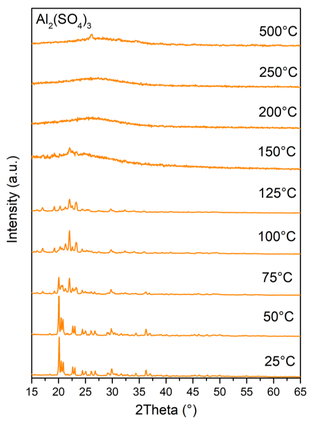

Hybrid fibres


Characterization

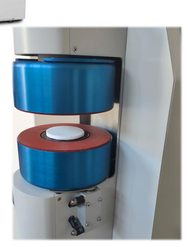
RESULTS

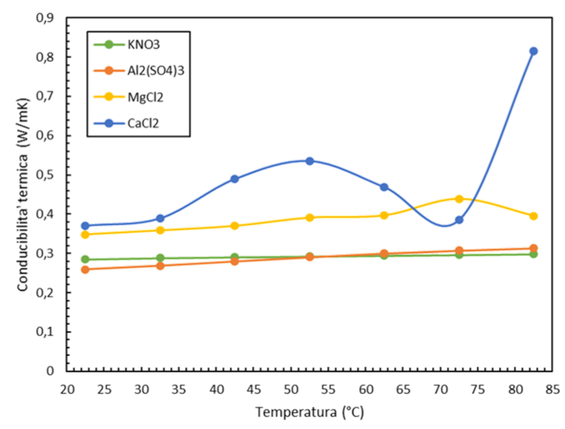






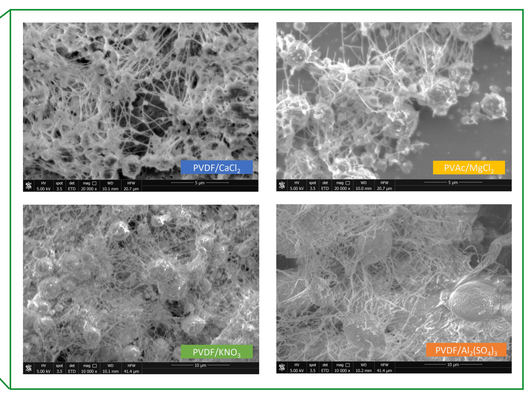
XRD vs Temperature of hydrated salts





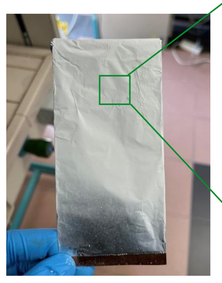
Thermal conductivity of hydrated salts

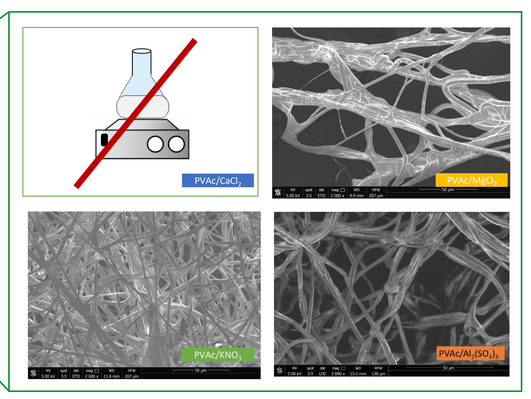
Hydrated salts encapsulated in PVDF polymer



PVDF fibers are thin and hydrated salts are only partially embedded in their structure, resulting highly exposed to the surrounding environment.

Hydrated salts encapsulated in PVAc polymer





PVAc fibers are thick and hydrated salts are completely embedded and integrated in their structure, being completely isolated from the surrounding environment.

CONCLUSION

- Polymeric matrixes, such as polyvinyl acetate and polyvinylidene fluoride, were used to encapsulate salt particles, as potassium nitrate, aluminum sulfate, calcium chloride and magnesium chloride.
- The electrospun fibers were able to assure salts properties while preventing leakage phenomena, especially in the PVAc-based samples.
- Resulting materials exhibited outstanding characteristics such as high surface-to-volume ratio and flexibility, hindering excellent mechanical performance.

REFERENCES

[1] Kiyabu, S. et al., Journal of the American Chemical Society, 2022, 144(47), 21617-21627.
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[3] Frontera, P., et al., Sustainability, 2022, 15(8), 6567.

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