

Alternative green solvents for the synthesis of perovskite nanocrystals

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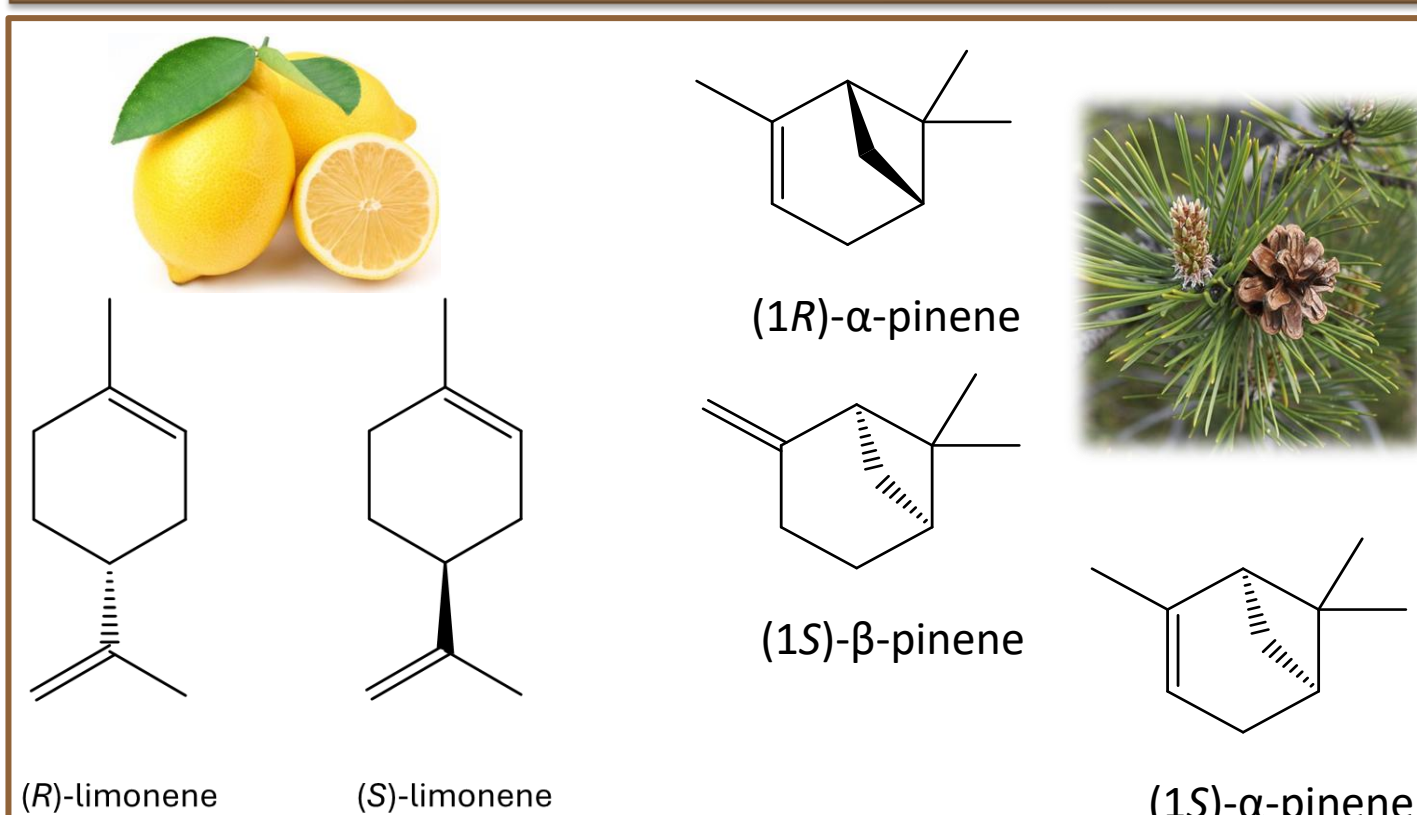
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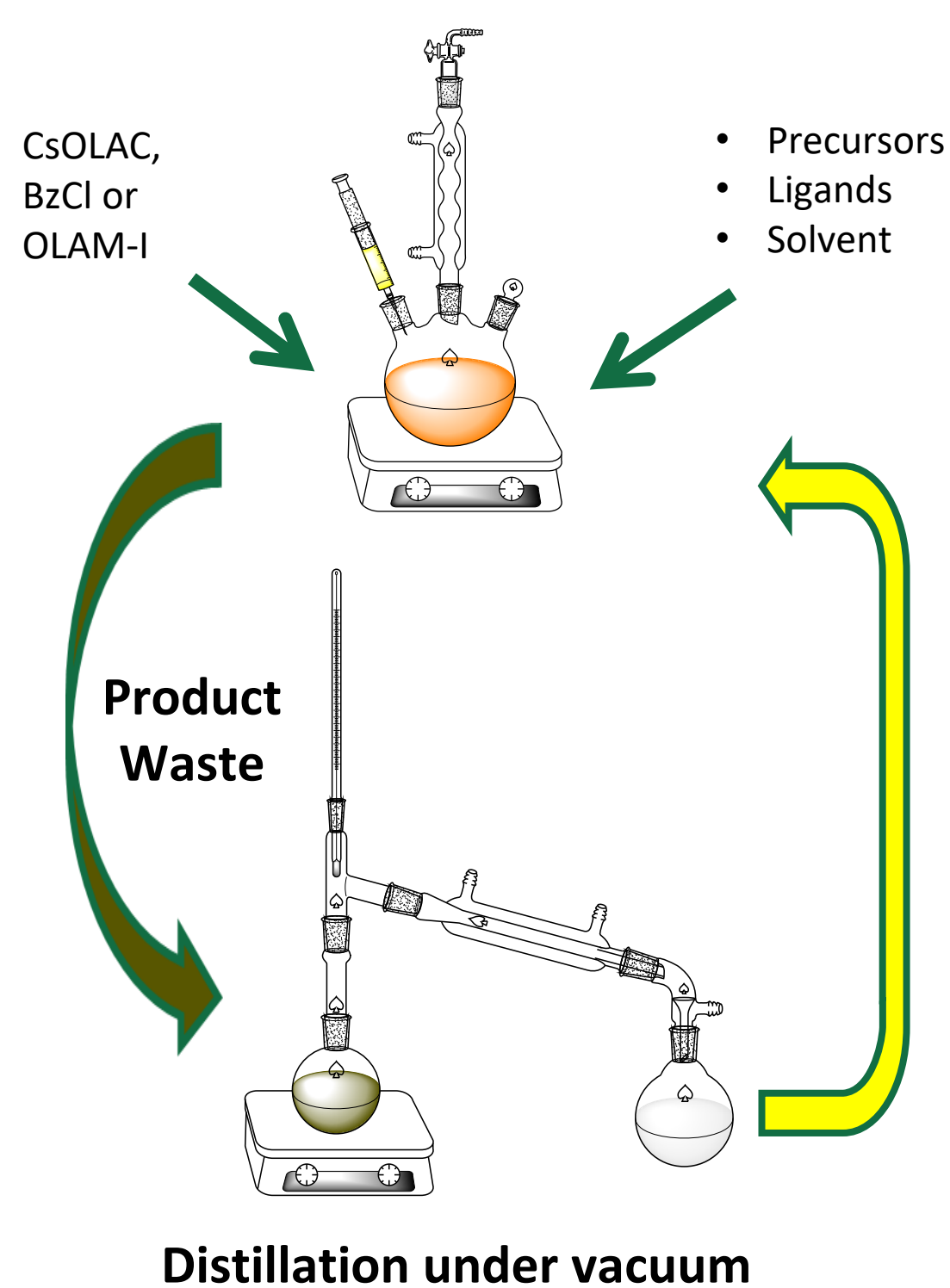
INTRODUCTION & AIM

Metal halides perovskite nanocrystals (MHP NCs) are an important class of materials currently widely studied due to their physical properties such as high electron mobility, low trap density, tunable and high emission. One of the most used synthetic strategies to prepare MHP NCs is the Hot Injection Method (HInj) that allows a precise control over size and morphology, reflected in a control of the optoelectronic properties of the final material. HInj involves the rapid injection of the precursor (e.g. Cs⁺ salt) into a solution of a non-polar solvent with high boiling point in presence of the other precursors (e.g. PbX₂ salt) and one or more organic ligands (alkyl carboxylic acid and amine), under inert atmosphere and at a temperature generally between 140 °C and 200 °C. Here, we replace the traditional solvent (1-octadecene) with the limonene and pinene molecules, that are considered green solvents. The relatively high volatility of limonene and pinene can then be exploited for their recovery from the waste of the reactions and their reuse for subsequent syntheses.

METHOD



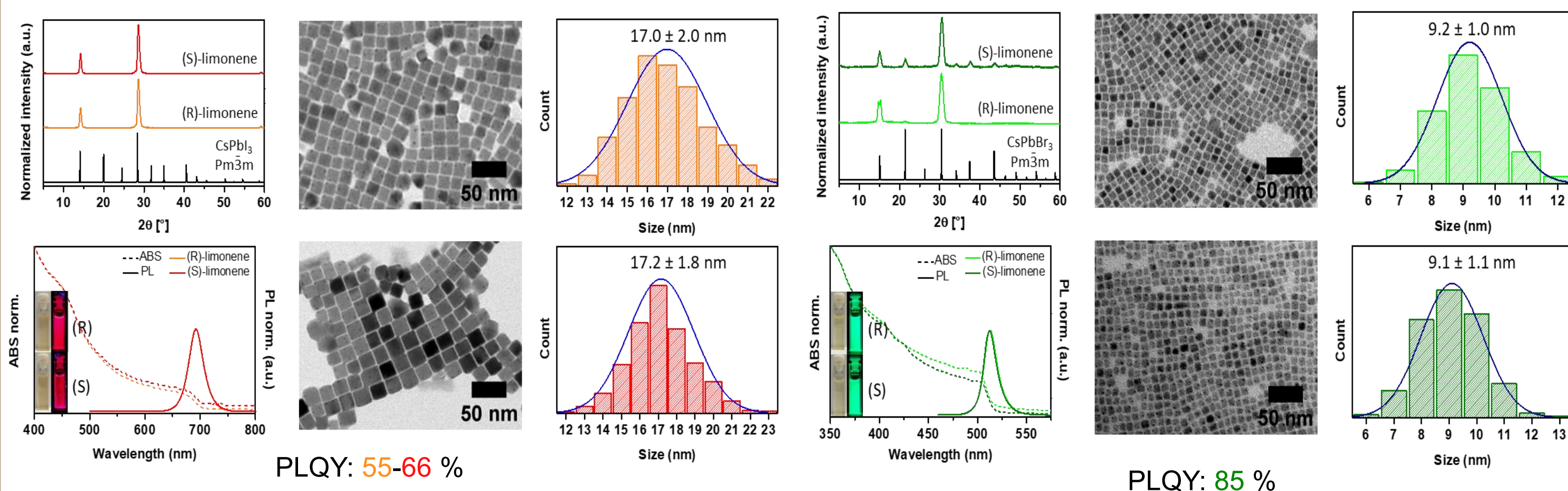
Hot Injection Method



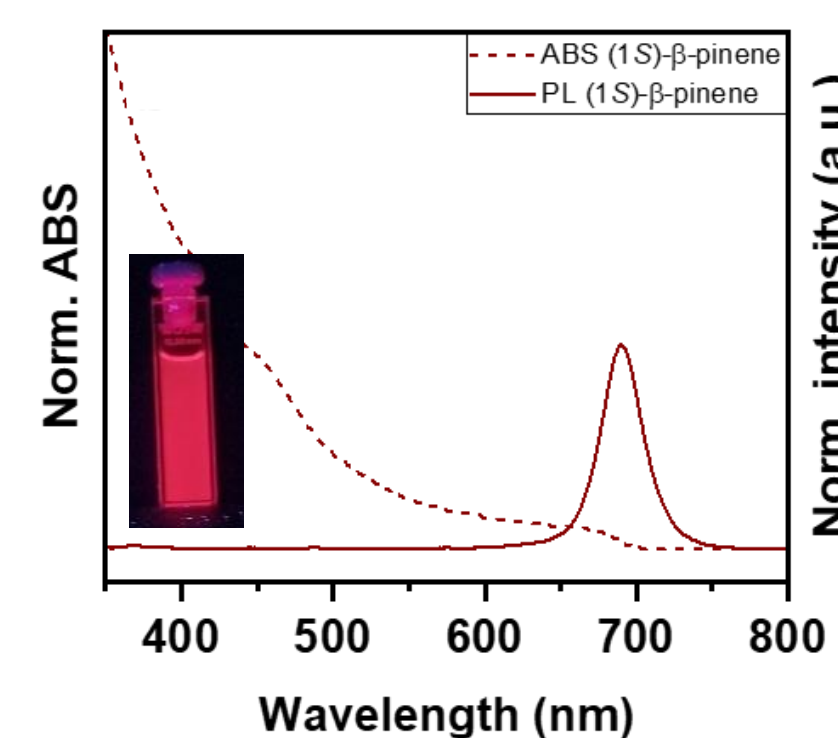
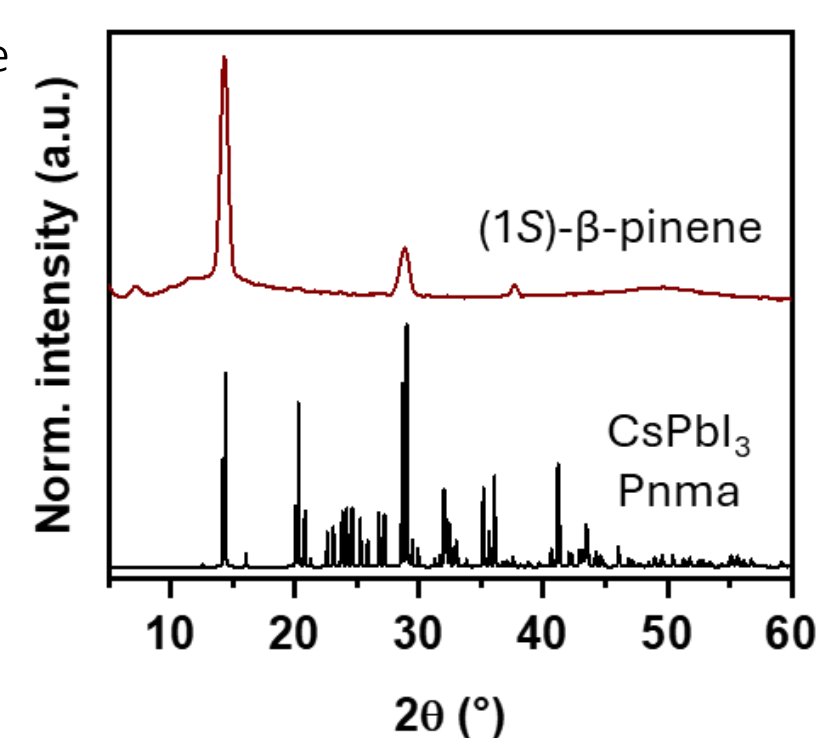
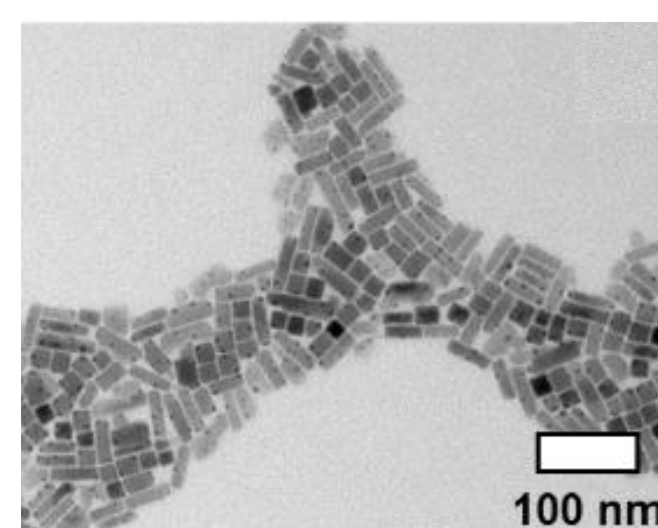
RESULTS & DISCUSSION



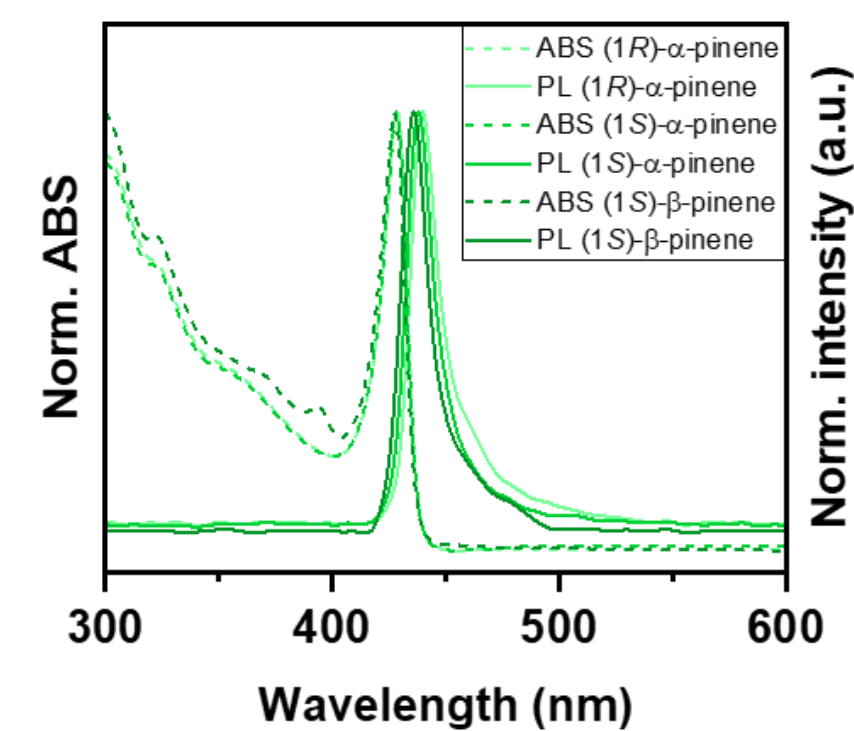
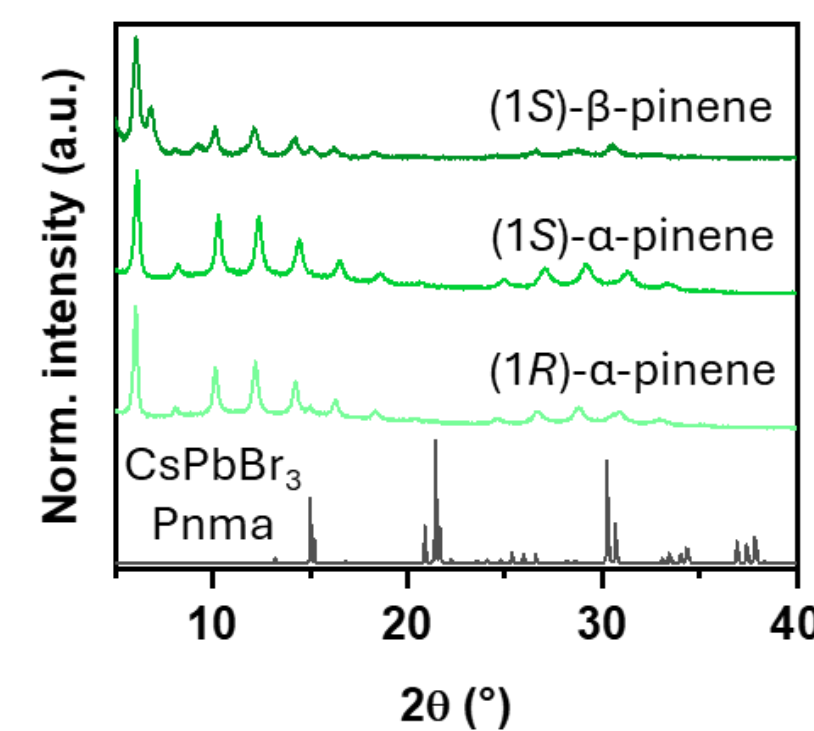
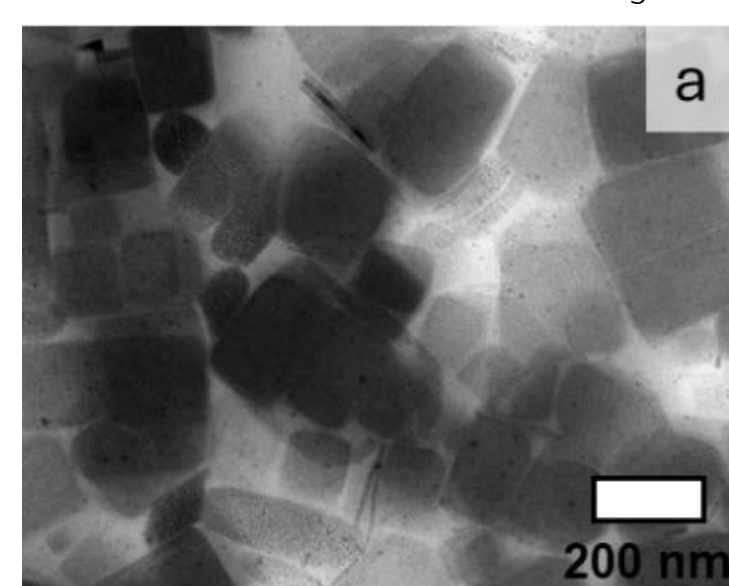
The synthesis of lead halide perovskites in limonene are consistent with the results obtained in 1-octadecene, especially for the high values of the PLQY



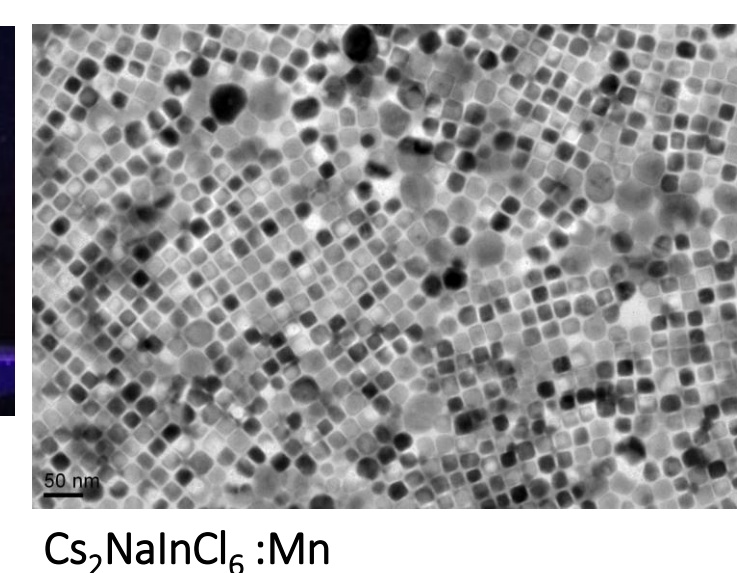
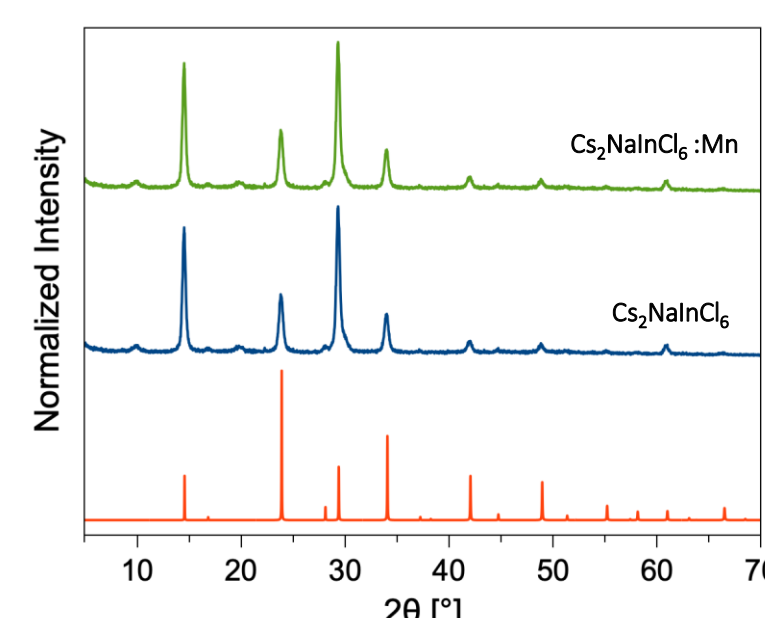
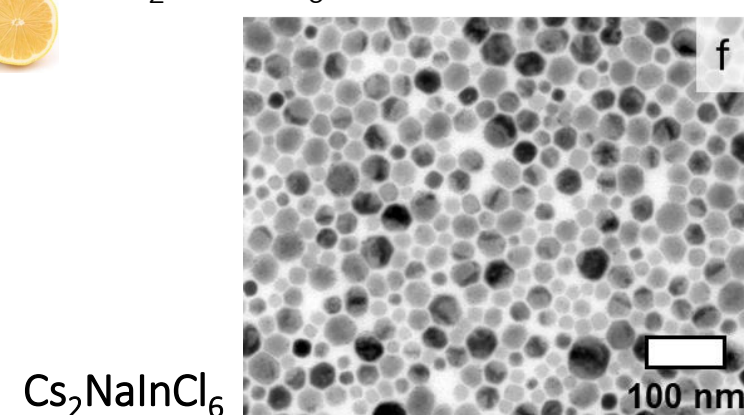
The synthesis of CsPbI₃ in pinene induces the formation of nanorods



The synthesis can be extended to the nanoplates, e.g. CsPbBr₃



The limonene and pinene can be used also for the synthesis of lead-free perovskite, e.g. double perovskites Cs₂NalInCl₆.



CONCLUSION

The limonene and pinene, molecules considered green solvents, can be employed for the synthesis of metal halides perovskites. Interestingly, the methodology can be expanded from the lead-based to the lead-free materials. Moreover, the solvents forming the waste of the reaction can be distilled and reused, further reducing the environmental impact of the synthesis. We believed that this strategy will be helpful in the nanocrystal community also beyond the perovskite nanocrystals.

FUTURE WORK / REFERENCES

- A. Dey et al, State of the Art and Prospects for Halide Perovskite Nanocrystals, ACS Nano 2021, 15, 7, 10775–10981
- D. Pratolongo et al, Lead Halide Perovskites Nanocrystals Synthesized in a Green, Reusable Solvent, Small 2025, 2500535
- F. Locardi et al, Colloidal Synthesis of Double Perovskite Cs₂AgInCl₆ and Mn-Doped Cs₂AgInCl₆ Nanocrystals, J. Am. Chem. Soc. 2018, 140, 40, 12989–12995



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