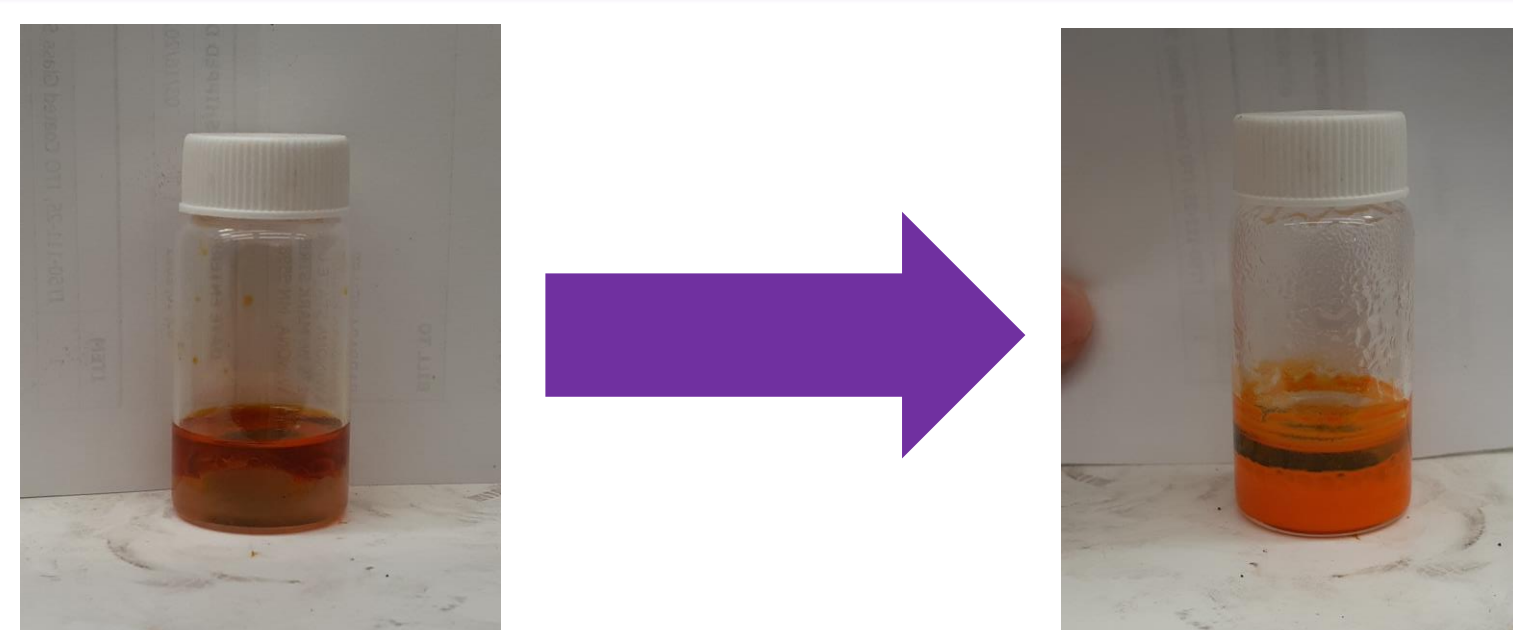


## Introduction

- CdSe nanoparticles (NPs) are popular candidates for use in solar cells
- Semiconductor NPs are tunable by size and surface chemistry
- These NPs can undergo Multiple Exciton Generation (MEG) to help increase efficiencies of solar cells
- The specific ligands used in this study were chosen due to their relatively short and less insulating structure compared to the native OLA ligand

## Methods



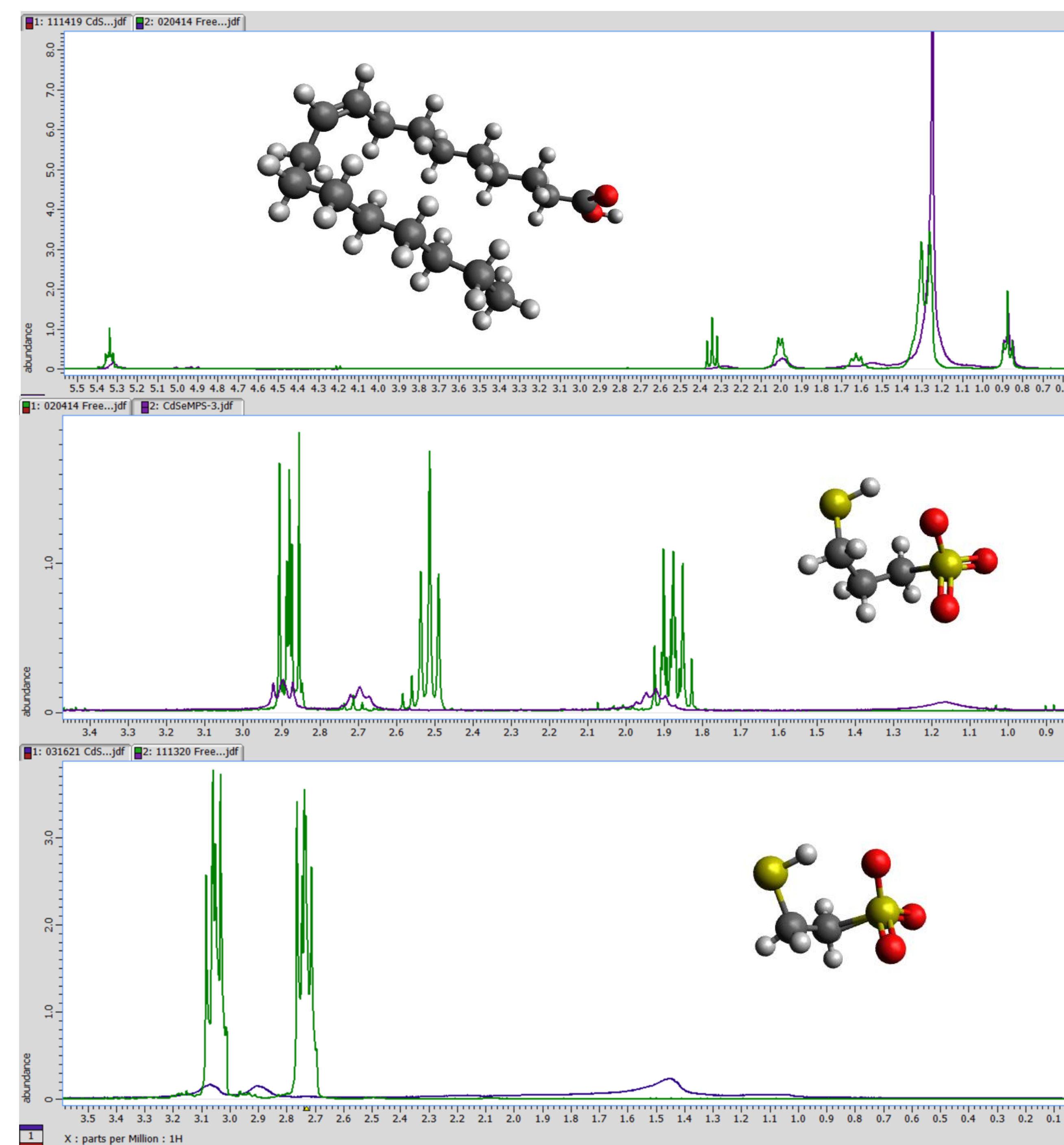
Detailed methods can be found online by scanning the QR code

All NPs were characterized by <sup>1</sup>H NMR, FTIR, and UV-Vis spectroscopy. The NMR and FTIR spectra help determine if the ligands are bound to the NP surface, and the UV-Vis is used to determine the size of each NP batch

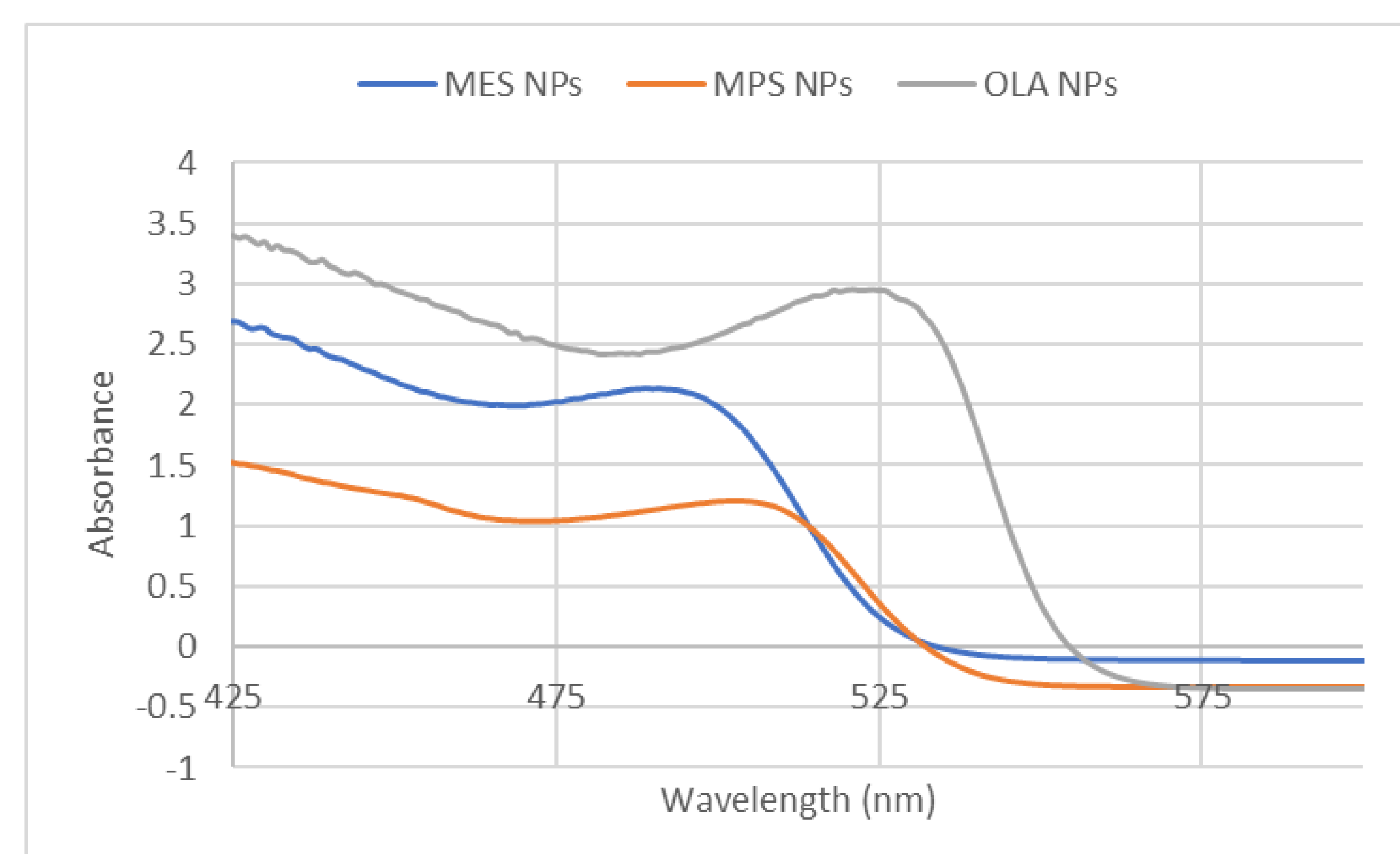
## References

- Zemke, J. M.; Franz, J. A Biphase Ligand Exchange Reaction on CdSe Nanoparticles: Introducing Undergraduates to Functionalizing Nanoparticles for Solar Cells. *J. Chem. Educ.* 2016, 93 (4), 747–752. <https://doi.org/10.1021/acs.jchemed.5b00847>.
- Bauer, C. A.; Hamada, T. Y.; Kim, H.; Johnson, M. R.; Voegtler, M. J.; Emrick, M. S. An Integrated, Multipart Experiment: Synthesis, Characterization, and Application of CdS and CdSe Quantum Dots as Sensitizers in Solar Cells. *J. Chem. Educ.* 2018, 95 (7), 1179–1186. <https://doi.org/10.1021/acs.jchemed.7b00593>.
- Yu, W. W.; Qu, L.; Guo, W.; Peng, X. Experimental Determination of the Extinction Coefficient of CdTe, CdSe, and CdS Nanocrystals. *Chem. Mater.* 2003, 15 (14), 2854–2860. <https://doi.org/10.1021/cm034081k>.

## Results and Discussion



- Broadening of the ligand NMR signals indicates that the ligands are successfully bound to the NP

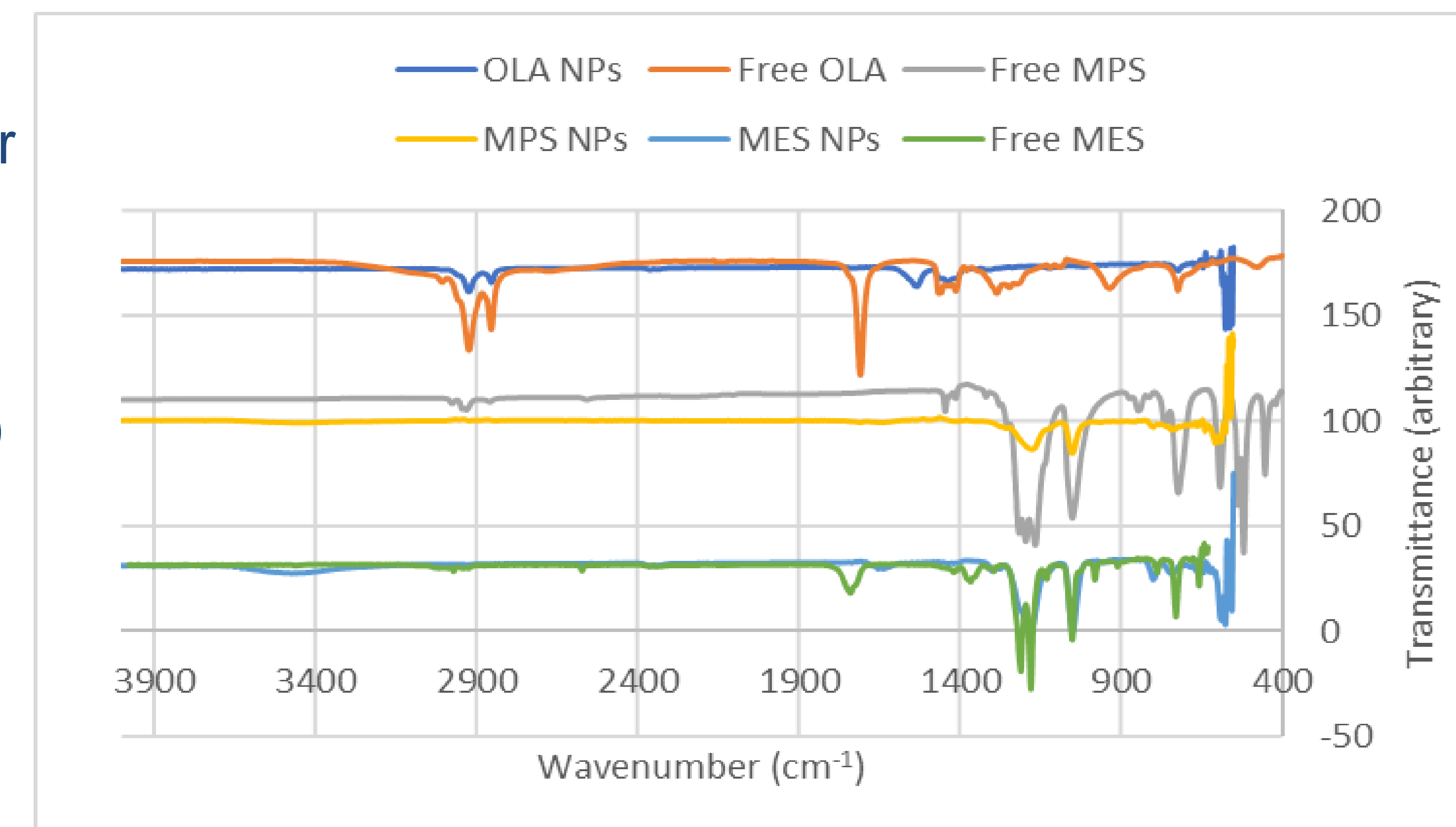


- The first exciton peak of the UV-Vis spectra allows for the NP size to be estimated<sup>3</sup>

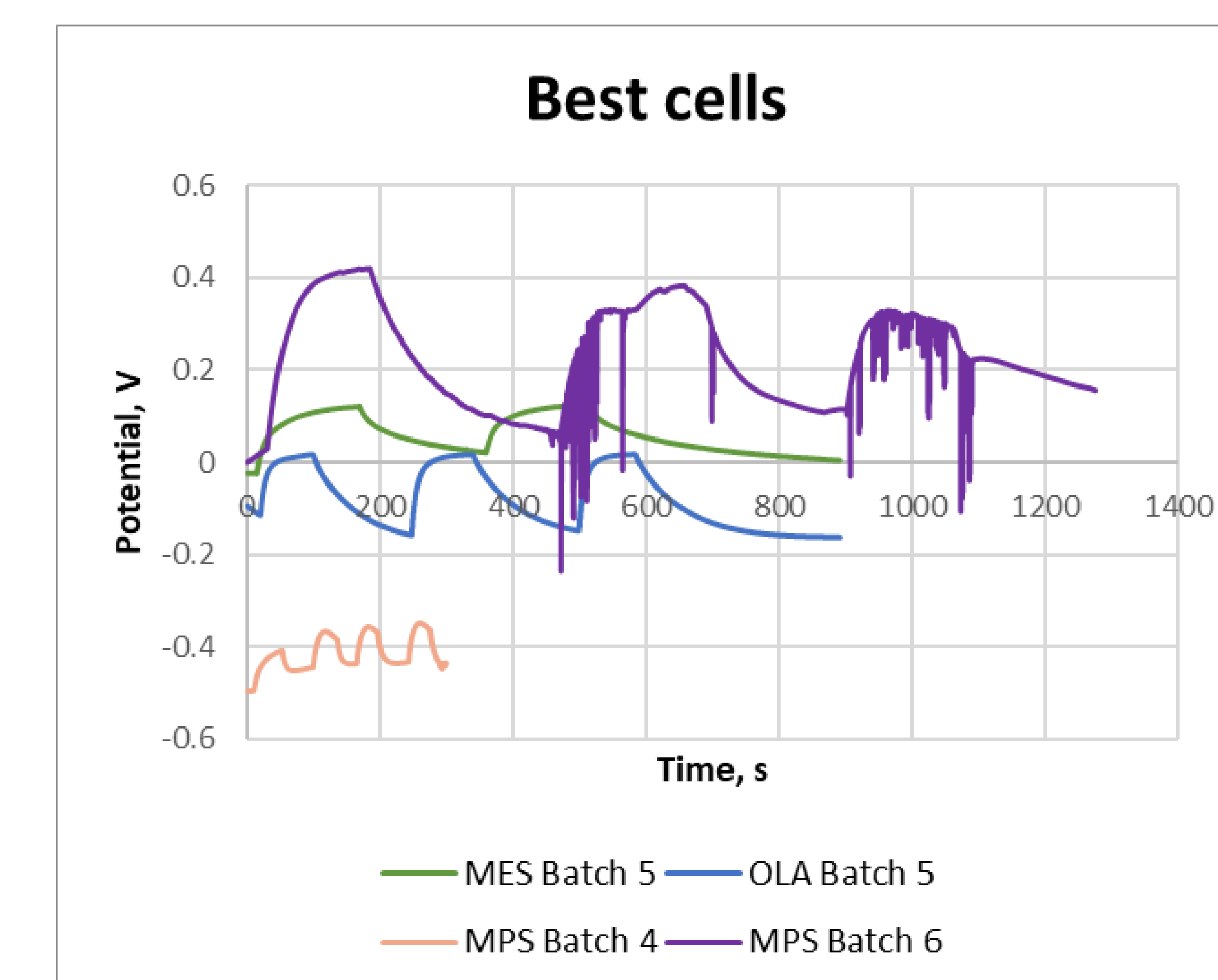
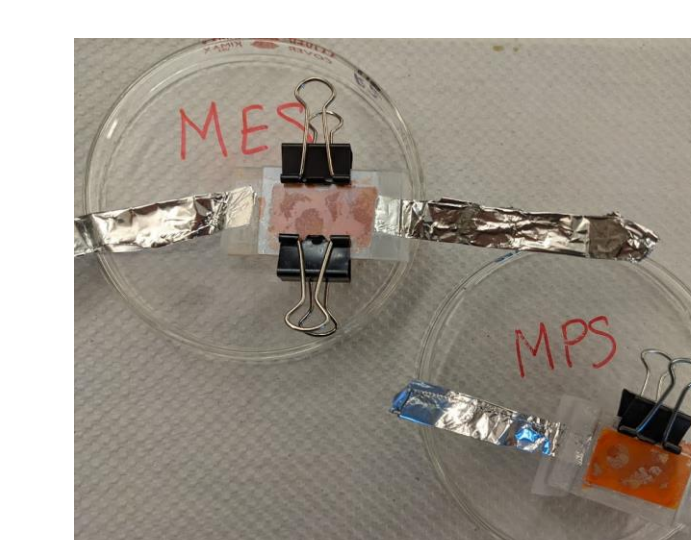
NP	OLA	MPS	MES
Size <sup>3</sup> (nm)	2.57	2.36	2.25

- Loss of a C=O peak at 1700 cm<sup>-1</sup> from the free OLA indicates OLA is bound to the NP through the carboxylate group

- Strong S-O stretch near 1040 cm<sup>-1</sup> and loss of SH stretch (2500 cm<sup>-1</sup>) indicates binding of MPS/MES on the NP surface



- All solar cells showed a photoresponse to a halogen lamp
- Cell performance is highly inconsistent
- The most consistent cell performance is for CdSe-OLA



## Conclusion

- CdSe nanoparticles were successfully synthesized
- The ligand exchanges from OLA to MES and MPS were also successful
- The performance of the solar cells so far has been sporadic. Further testing and enhancement of the protocol to create the cells is needed to definitively infer how the ligand influences cell performance

## Acknowledgments

WSU Research & Creative Project Grant for funding and materials; WSU Travel Grant