

TESTING A NEW MATERIAL FOR NEW HOPE FOR CLEAN ENERGY FOR THE FUTURE

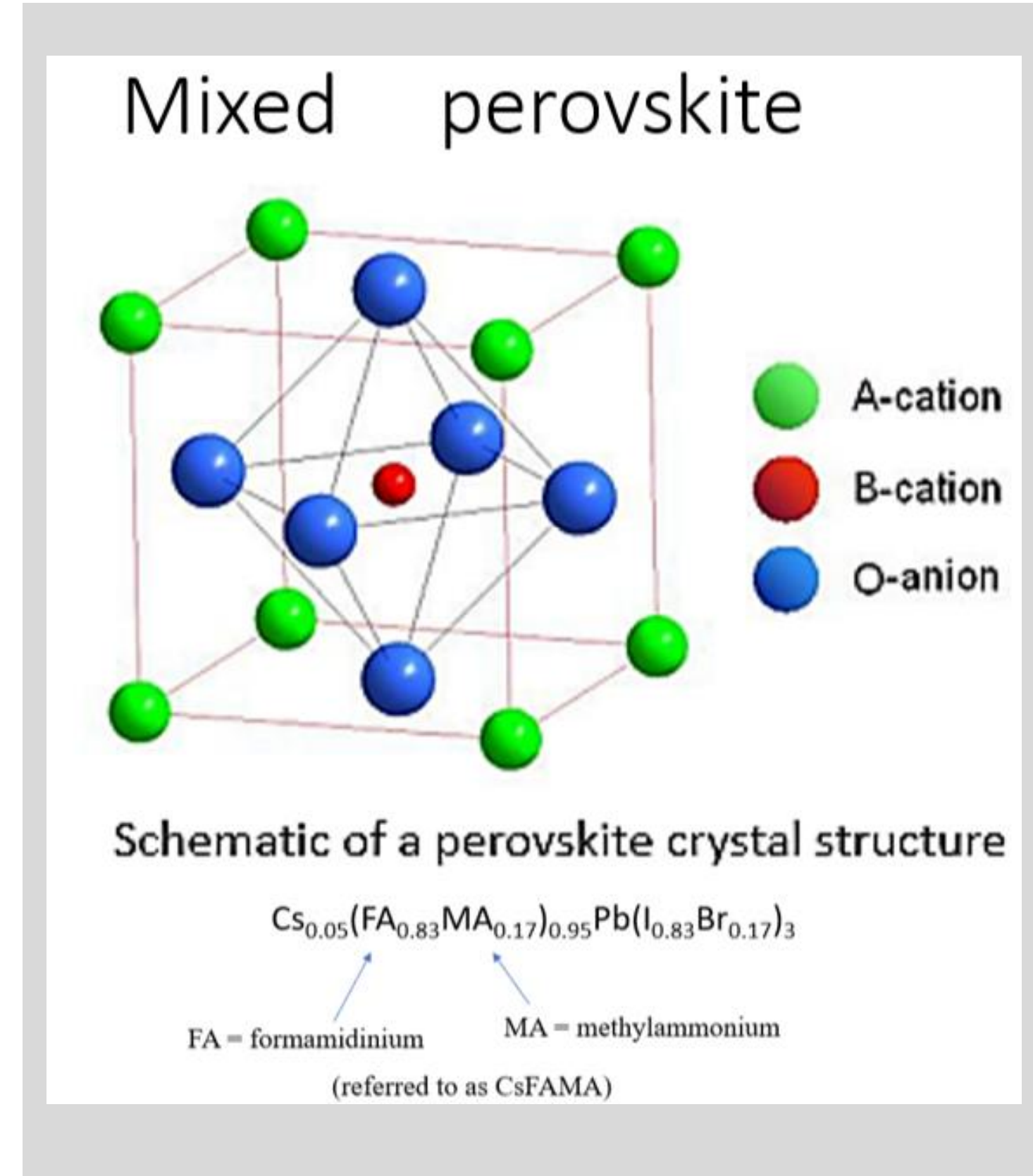
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ABSTRACT

This research program, conducted in collaboration between Waubonsie Valley High School students and teachers, as well as Argonne researchers, aims to investigate the molecular structure and composition of perovskites using the synchrotron x-ray tunneling microscopy technique at Argonne's Advanced Photon Source. The Exemplary Student Research Program has proposed this research program to gain critical insight into possible problems with the utilization of perovskites and to provide crucial information on their potential utilization in solar panels. Perovskites have emerged as a promising material for solar panel technology due to their performance and affordability compared to traditional silicon cells. By using the synchrotron x-ray tunneling microscopy technique, this research program seeks to explore the molecular properties of perovskites and understand their potential as an alternative source of clean energy.



MOTIVATION

In the past 12 years alone, the global population has grown by 1.5 billion people. This large amount of growth demands for more accessible and safe energy in order to maintain quality of living and develop various communities across the globe.

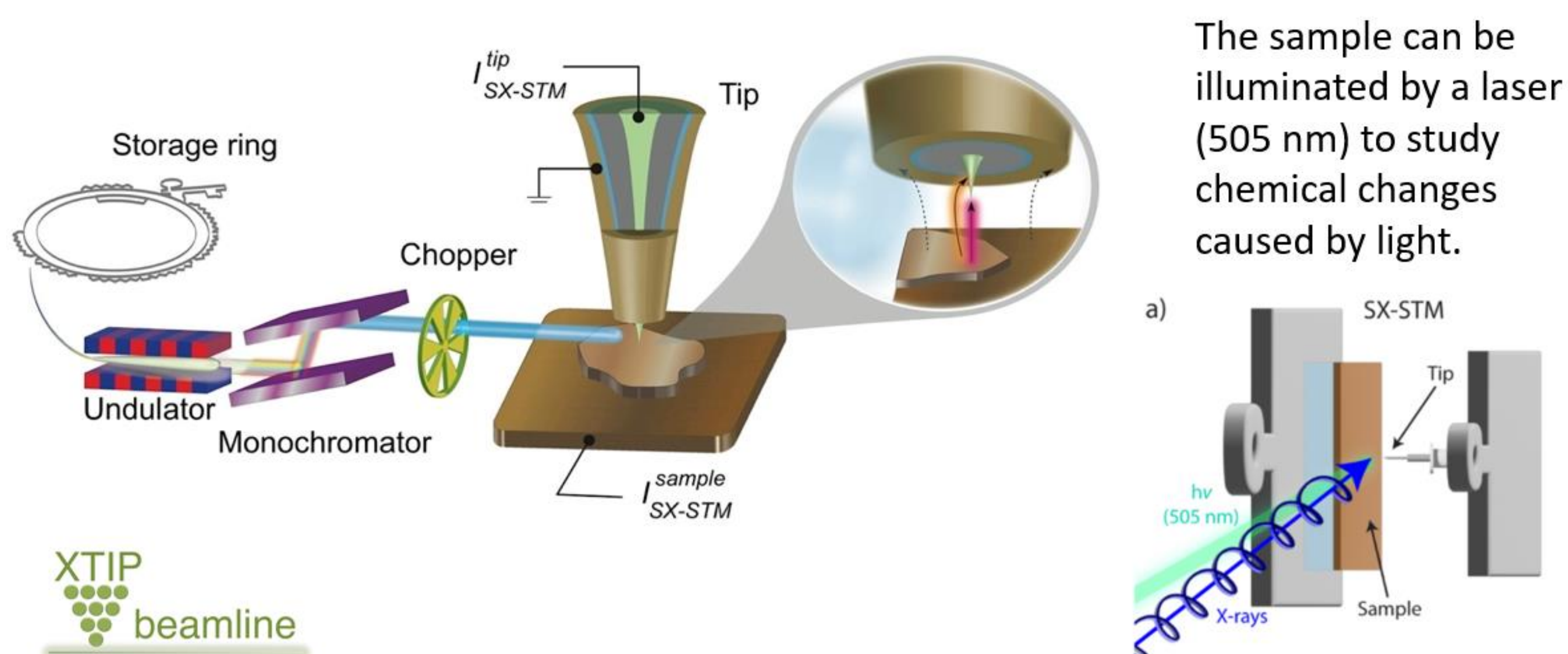
Solar energy is accessible in all habitable areas across the globe, making solar energy the most reliable and renewable form of energy to accommodate the rising global population.

As of right now, perovskites are not very stable and only last a year at most, whereas silicon solar cells can last for 25 years or more. Since we want perovskite solar cells to be more cost-efficient, we need to figure out how to prolong the usable lifespan of the perovskites.

The purpose of this experiment is to try to understand the mechanisms of the degradation of perovskite solar cells under conditions that simulate their operation in the field. The experiment will involve applying the synchrotron x-ray tunneling microscopy technique on perovskites for the purpose of investigation into its molecular structure and composition. This will be done in order to provide crucial information on the potential utilization of this material in solar panels and to gain critical insight into possible problems with its utilization.

EXPERIMENTAL SET UP

The SX-STM technique utilizes a smart tip to collect x-ray excited electrons from the sample.



ATOMIC FORCE MICROGRAPHS OF PEROVSKITES

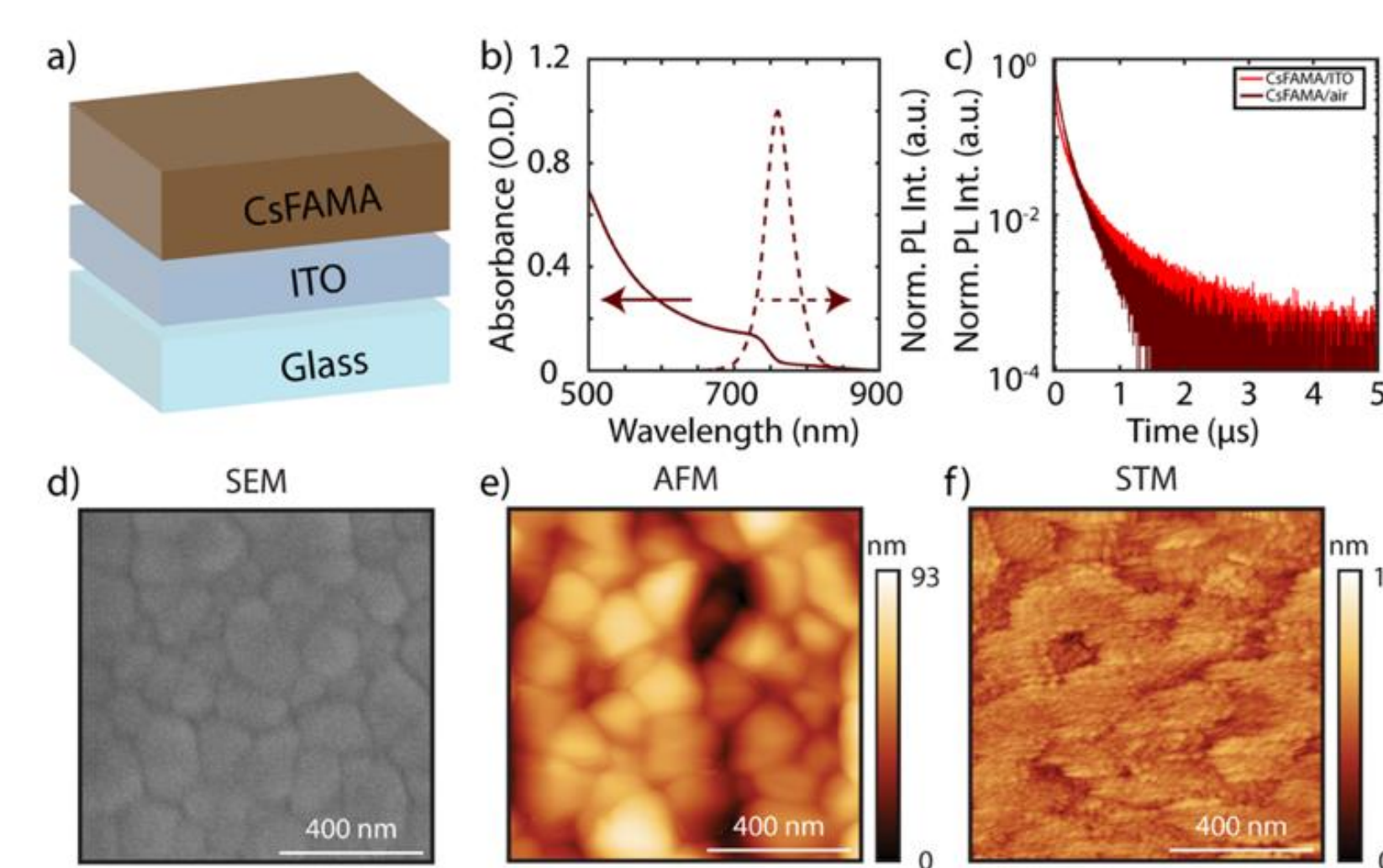
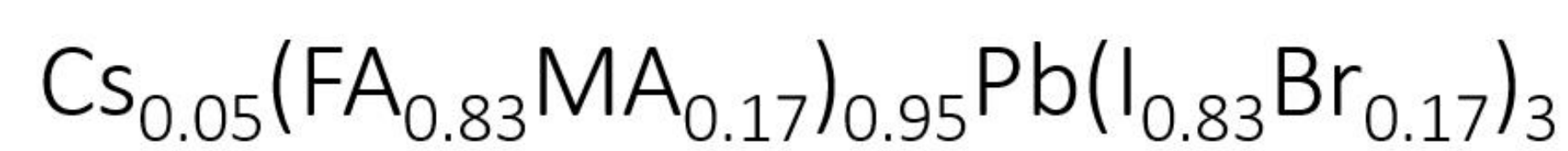


FIGURE 1

TEY light and no light

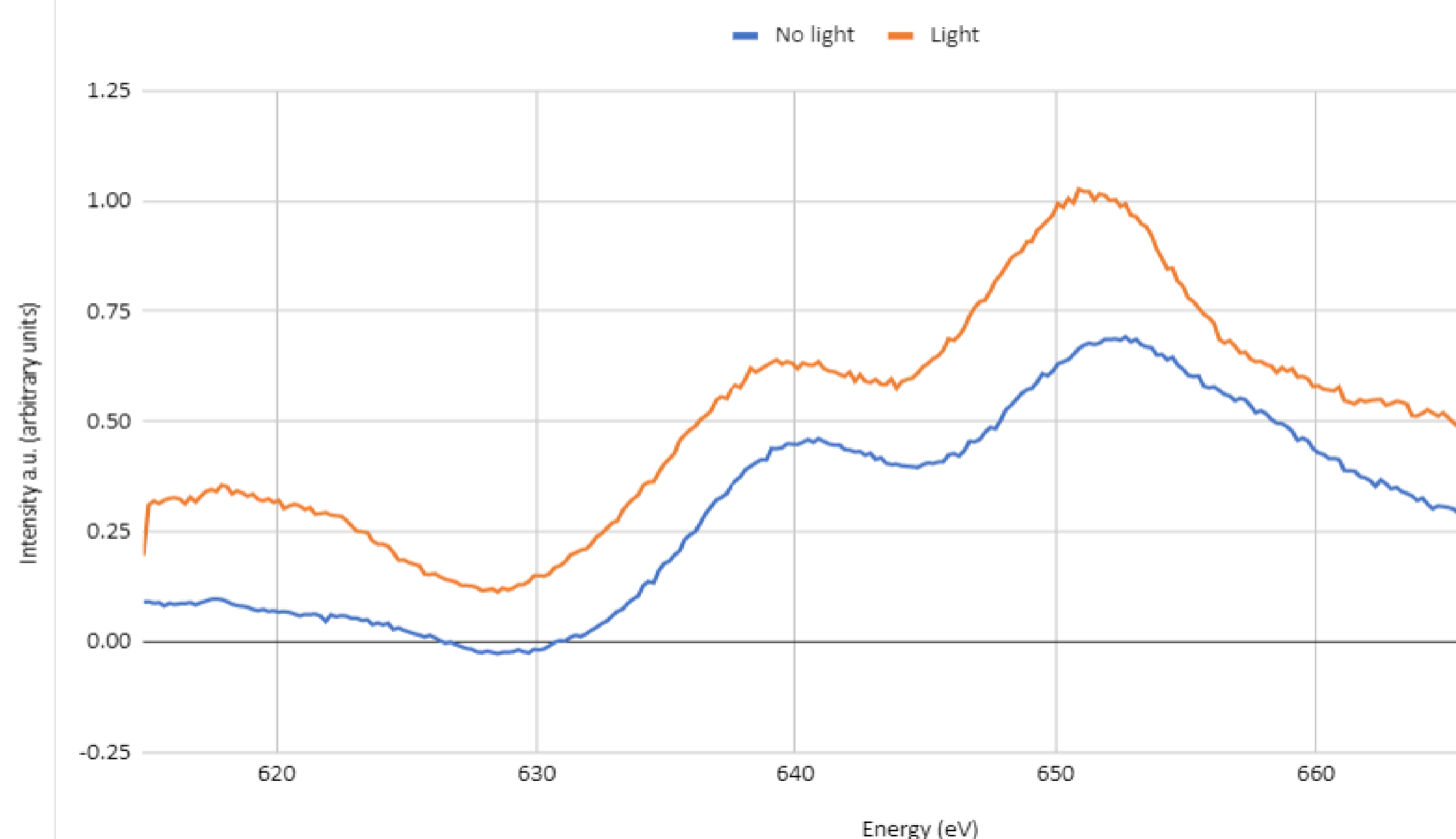
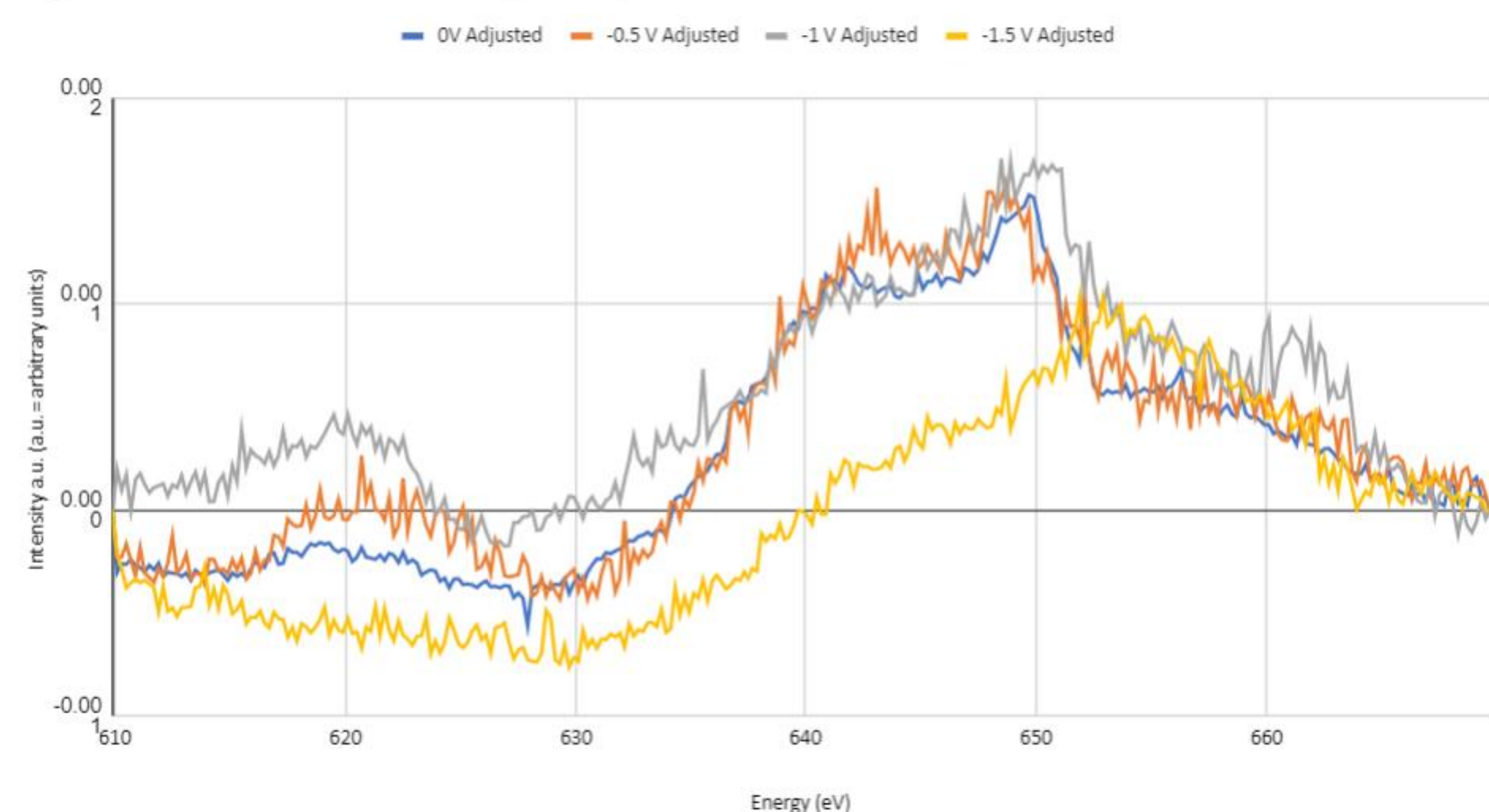


FIGURE 2

TEY voltage

Figure 2 - Iodine m 0.83 TEY Voltage Comparison



CONCLUSIONS

- It seems that light does not have a significant effect on the photoelectron density output distribution of the material as the peaks of the graph are located at the same eV, suggesting that the local chemistry is not impacted. Figure 1 displays this data.
- Applying voltage to the perovskites material does have an effect on the photoelectron density output distribution, with the voltage being proportional to the amount of shifts that had occurred to the peaks on photoelectron yields. This suggests that the applied voltage leads to diffusion that might ultimately be a cause for the degradation of perovskite-based photovoltaics. Figure 2 shows this data.

FUTURE DIRECTIONS

- The results revealed that light has no significant impact, proving that the perovskite sample is more than capable of withstanding light conditions without degradation. This lack of degradation shows that the perovskite is better suited for real-world conditions, like long-term sunlight exposure. However, it appears that in order to improve the efficiency and life time of perovskites material, one needs to address structural alterations in the material due to an external electric field, so to produce a material better adapted to concurrent photovoltaic cell designs.

REFERENCES

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