Challenges to Measuring Resistivity in CH$_3$NH$_3$PbI$_3$ Films

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How Solar Cells Work

- Electrons in a material are excited to higher energy states
- These electrons move to one side of the cell


http://blogs.cas.suffolk.edu/kdshepard/files/2013/03/solar_pv_diagram.jpg
Perovskite Solar Cells

- Composed of $\text{CH}_3\text{NH}_3\text{PbI}_3$ crystals
- Band gap is aligned with the energy from photons in the solar spectrum
Perovskite Advantages

- Absorb light better and are thinner than silicon
- Solar cells have reached efficiencies in the 20% range

Perovskite Disadvantages

- Crystals degrade in the presence of water
- Chemicals released in the degradation reaction are toxic

\[ \text{CH}_3\text{NH}_3\text{PbI}_3 \rightarrow \text{I}_2 + \text{PbI} + \text{CH}_3\text{NH}_3\text{I} \]
Degradation from Light

- Surface potential of perovskites would not change back after turning off a light source

(Images courtesy of Sarah Nathan)
Methods

Film Making

- Solutions of PbCl$_2$, Dimethylformamide (DMF), and methyl ammonium iodide (MAI) were made.
- The solution was either drop or spin cast on glass.
Methods

- Films were placed in a box that was flushed with nitrogen
- A small LED was directed at the sample
Methods

• A four point probe test was conducted to measure resistivity
Results

- The probes measured a voltage of 1.23 V on copper tape when sourcing 1 amp of current.

- The perovskite samples had a measured voltage of 21 V
Possible Issues

- The perovskite film on the glass was soft and wet
- The film was very uneven and did not cover the glass completely
Future Experiments

- Another substrate may be used
- Exposure to moisture would be minimized
- Improvement to controlling contact strength
- Lead acetate may work better in creating films rather than lead chloride
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