# High Quality 2-Dimensional Perovskite Photovoltaics Produced with PVP

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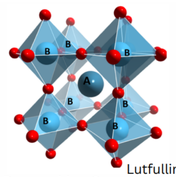
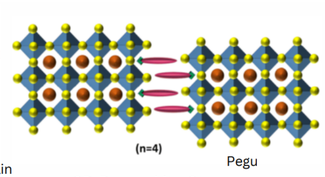
## Background:

Perovskites are a class of materials that have the structure of ABX3, where A and B are cations and X is an anion. Many different cations can be embedded in this structure which allows the improvements of diverse engineered materials needed for different applications.

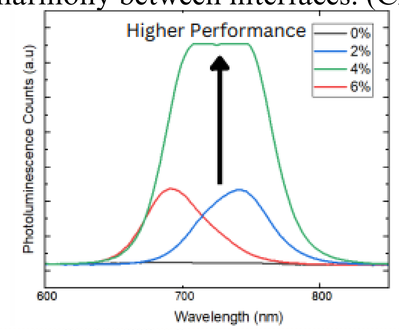
2-Dimensional Dion-Jacobson (DJ) perovskites have a layered structure with organic cations sandwiched between inorganic "n" amount of layers. The name Dion-Jacobson comes form the Dion-Jacobson phase.

- Perovskites offer a low-cost and high-efficiency prospects for solar power.
- The structure of 2D DJ perovskites have provide more resistance to environmental factors such as heat, moisture, and light.




PVP (polyvinylpyrrolidone) can enhance the quality and functionality of perovskite materials by altering the crystallization process, reducing the flaws, and creating a harmony between interfaces. (Chen, Dai)

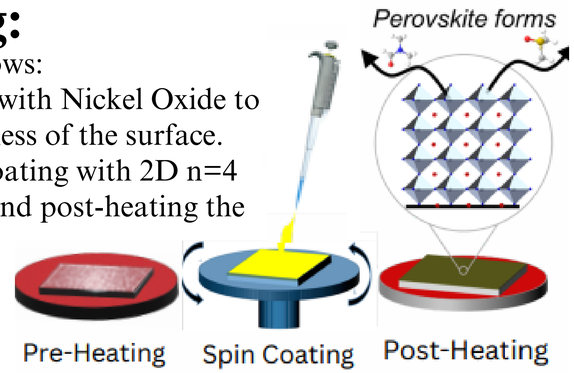



From previous work done it can be seen that Propane-1,3-diammonium iodide with 4% PVP has the highest efficiency, which was the motivation to work on them during this experiment. (Gokce, Berrak)

## Processing:

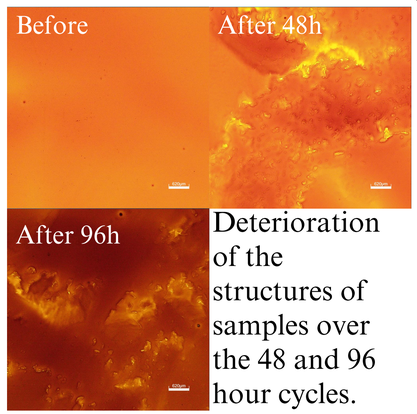
The process is as follows:

- Coating substrates with Nickel Oxide to increase the roughness of the surface.
- Pre-heating, spin coating with 2D n=4 with 4% PVP ink, and post-heating the substrates.




Aging Process:

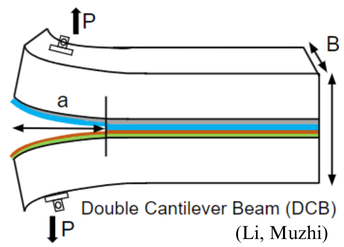
- Samples were done according to the process.
- The microscope pictures and PL (photoluminescence) measurements were done before and after holding the samples in a dry glovebox and on a hot plate (at 85C) for 48 and 96 hour cycles.



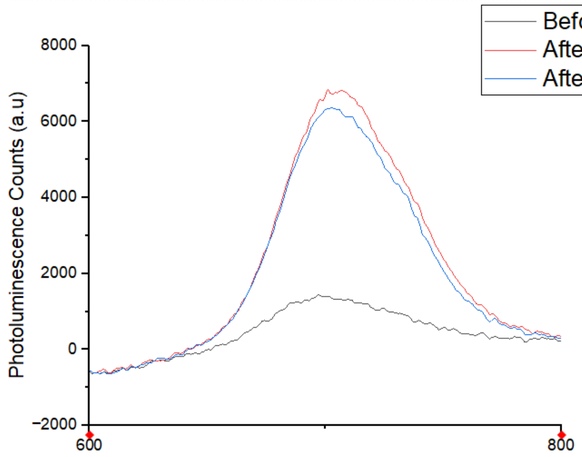

Deterioration of the structures of samples over the 48 and 96 hour cycles.

Fracture Test Process:

- Samples were done according to the process but were layered with PMMA, silver, and epoxy respectively.
- Then they are put in the testing machine to simulate the outside affects by putting the samples in tensile and compressive cycles.
- This test shows how many cycles it would take for the samples to fracture over time, in the real world.

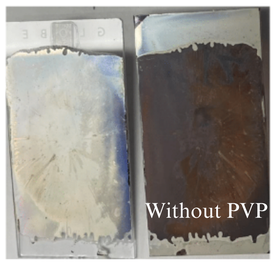


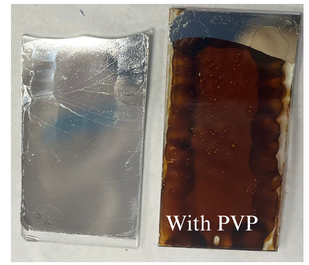

(Li, Muzhi)

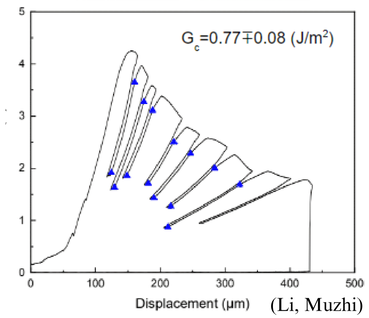



$$G_c = \frac{12P_c^2a^2}{B^2E'h^3}\left(1+0.64\frac{h}{a}\right)^2$$ ➡ Fracture Energy Formula

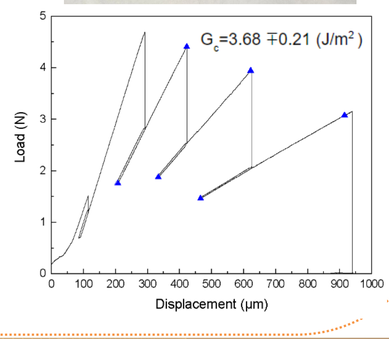
Fracture energy increased by >5X with the incorporation of PVP




(Li, Muzhi)

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