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CURRENT AND VOLTAGE BIAS STRESS EFFECTS IN CHEMICAL VAPOR DEPOSITION MADE PEROVSKITE PHOTOVOLTAIC DEVICES

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Background: Perovskites have been receiving a large amount of attention as they can be tailored to certain semiconducting properties and can lead to various functionality and optoelectrical applications. While chemical vapor deposition (CVD) is a system that is being used as a deposition process for making perovskites due to the widespread control of its internal environment.

Purpose/Research Question: The purpose of this study is to investigate the process of making perovskites with CVD and how the morphology, crystallite orientation, and temperature changes in the perovskite structures affect the current behavior observed in devices while under a range of voltage bias stress in both light and dark conditions.

Methodology: Lead-iodide films were made by spin coating a lead-iodide solution (463 mg/mL) on glass and using a powdered methyl-ammonium iodide as a reactant deposited on the glass in the CVD to create perovskites. Temperatures are tested from 120 to 140 degree Celsius; nitrogen was tested at flow rates ranging from 100 to 150 mL of nitrogen; reaction times were tested from two to four hours. After each of the films were made, they were analyzed with X-ray diffraction (XRD) to understand the morphology of the perovskite and to continue and improve on the parameters towards creating the perovskite.

Results: The study found that with the XRD the parameters that created a perovskite that was closest to a fully reacted perovskite were 140 degrees Celsius, 120 mL of nitrogen, and a reaction time of 210 sec. However, the perovskite still has not fully reacted so there are better parameters that still need to be worked through.

Discussion: The findings suggest that there are other approaches that still need to be taken into consideration before getting a full understanding of the morphology, crystallite orientation, and more on the electrical behavior. The results depict specific temperatures and reaction times for the CVD processes to create a full widespread perovskite made from the reaction between methyl-ammonium iodide and lead iodide. This can also lead to more precise findings on other processes that can produce better made films of different reactants.