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**Title of Thesis:** Cesium based all Inorganic Perovskite Solar Cells

**Abstract:** Perovskite solar cells have shown considerable amount of promise in the last ten years. Their efficiencies have improved at a dramatic rate surpassing some of the top PV materials such as CdTe and CIGS (copper indium gallium selenide) and caught up with that of silicon. At the same time simple and inexpensive growth methods possess immense potential for perovskites to become low-cost alternative to the presently available PV technologies. However, the organic-inorganic perovskites still face some of the fundamental barriers to their commercialization such as their instability against heat and moisture, ion migration (hysteresis) and phase instability causing device degradation and presence of lead – one of the most toxic chemical elements.

In our studies we propose the use of all inorganic perovskite material by substituting organic MA (Methylammonium) and FA (Formamidinium) cations with inorganic Cs and then by substituting iodine anions with bromine we manage to make our perovskite very stable against both heat and moisture with low hysteresis effects. Furthermore, our studies attempt to eliminate lead by using non-toxic element such as tin and bismuth. All the perovskite fabrication is done by vacuum evaporation instead of solutions processing - making the whole process scalable and well reproducible as well.

With the all inorganic perovskite - $CsPbBr\_{3}$ having large bandgap of 2.35 eV, we have been able to fabricate solar cell devices with planar N-I-P superstrate architectures which would possess record high open-circuit voltage of 1.69 eV corresponding to less than 1/3 of the voltage loss. We demonstrated change in optical and structural properties of perovskites when N-type bilayer of CdS:In@$TiO\_{2}$ was used as opposed to another N-type bilayer of ZnSe@$TiO\_{2}$, as well as single layer of $TiO\_{2}$. As an additional step of interfacial engineering, we managed to relieve crystal lattice strain of perovskites by depositing thin layer of $PbBr\_{2}$ after $CsPbBr\_{3}$ phase had already been formed, improving performance and efficiency beyond 8% compared to Shockley-Queisser limit of about 15%. We successfully eliminated deposition of expensive metals as Ohmic contacts with the coating of carbon paste, using doctor blading technique. Fabricated devices demonstrated excellent stability against air and heat.