# Pardon the disruption: how perovskites have made their mark in solar

**Nam-Gyu Park**

## Video Abstract

**Keywords:** MRS Bulletin, Sungkyunkwan University, halide perovskite, photovoltaic (PV), perovskite solar cell (PSC), power conversion efficiency (PCE), light-emitting diode (LED), resistive memory, X-ray imaging, disruptive technology, defect tolerance, methylammonium lead iodide, grain size, photoluminescence (PL), external quantum efficiency (EQE), recombination, Lewis acid-base adduct, passivation, grain-boundary engineering, interfacial engineering

**Posted Date:** September 20th, 2019

**DOI:** https://doi.org/10.21203/rs.2.14971/v1

## Abstract

Disruption. For better or worse, perhaps no other buzzword better captures the spectacular pace of technology over the past few decades. Though it's casually attached to any new app or gadget hatched in the tech world, several examples of true technological disruption surround us today. One of the most compelling is perovskite-based solar cells. With a power conversion efficiency that now tops that of their silicon predecessors, these rapidly developing devices stand to make a meaningful impact on the solar energy market—and energy consumption at large. A perovskite is a compound possessing a crystal structure that looks like this. Some of the best performing perovskite materials used in solar cells feature an organic ion housed within an inorganic cage. This complex structure provides a chemical ruggedness not found in traditional solar cell materials. Economically, that translates to cheaper manufacturing. And in terms of operation, it means more stable performance. Add to that the ability to cast a wider light-capturing net across the solar spectrum, and it's easy to see why researchers have flocked to the study of perovskites. In fact, in only 5 years, the efficiency of perovskite solar cells has catapulted from about 10% to more than 23%. It took nearly 50 years to make the same improvement in silicon solar cells. But what's not immediately apparent is the series of "innovations within the innovation" that have enabled perovskite solar cells to rival traditional solar technologies—many of which have come from the research group of Dr. Nam-Gyu Park. One important advancement the group has made is to grow perovskite films with just the right grain size. Grains within these films act as tiny prisms that scatter light. More scattering leads to higher conversion efficiency in solar cells, and larger grains tend to scatter more light than smaller grains do—at least up to a certain point. The team has shown that above a certain size, grains become surprisingly vulnerable to defects that degrade performance. Of course, even at the optimal grain size, defects in other areas of perovskite films can hamper performance—whether between grains or at the interface with other layers of the solar cell architecture. Creating chemical bridges at these critical interfaces has proven to be the key to squeezing even higher performance out of perovskite films for photovoltaics, as well as for LEDs and X-ray imaging systems. More work is underway to push the performance limits of perovskites even higher. But already, these multifunctional materials may have reached a tipping point in the solar cell market, setting the stage for what could be one very valuable disruption.