# Optimized Growth and Surface Passivation of Organolead Halide Perovskite Single Crystals for Electromagnetic or Particle Radiat

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## OVERVIEW

A method for fabrication of uniformly passivated organolead perovskite material

- Produces crystals with minimal surface roughness for radiation detection optimization
- May also prove beneficial in production of perovskite solar cells

## BACKGROUND

Prolonged exposure of excessive gamma radiation exposure is known to carry risks to human health. Consequently, military security and defense, nuclear medicine imaging, and general environmental radioactivity monitoring all require sensitive gamma radiation detection. Perovskite semiconductors have been shown to be powerful gamma ray detectors with advantages in sensitivity and resolution compared to traditional methods. While perovskite is a mineral, in this setting it refers to a specific 3D structure type that possesses structural properties ideal for gamma ray detection and other photonic applications. However, the widespread adoption of these technologies can be limited by the complexity and cost associated with material fabrication. The thin film technology developed for solar cell perovskite do not translate well into gamma detectors. As such, a need exists for a reliable fabrication method for perovskite materials that perform gamma radiation spectroscopy at a level capable of replacing existing methods.

## INNOVATION

Researchers have invented a crystallization process as well as surface passivation techniques for producing organolead halide perovskite single crystals (PSCs) for the purpose of spectroscopic photon and particle detection. This innovation describes a solution-based method to coat the PSCs with mono- or multi-molecular layers of material chemically or ionically bonded to the PSC surface. The approach reduces the presence of surface gangling bonds and associated carrier trapping states within the PSC bandgap. This method builds on previous inverse-temperature crystallization methods to obtain crystals with minimal surface roughness, as characterized by SEM, and optimal radiation detection. The process therefore optimizes the crystallization process to creating smooth-surfaced PSCs exhibiting surface passivation necessary to produce reliable radiation detectors. Overall, the gamma radiation detection of these treated PSCs proves to be comparable to standard methods with increased resolution.

## Patent Application

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