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Vapor-Deposited Perovskite Film for Photovoltaic Applications

Background

Perovskites have been widely considered as promising next-generation materials for future display and solid-state lighting applications. Most perovskite LEDS are mainly produced via solution processing, and over 20% external quantum efficiencies (EQE) in LEDs have been achieved in recent studies. However, vacuum-based deposition has attracted tremendous interest in not only research but also industry. In light of the high reliability of vacuum processing and its ease of integration with OLED facilities, it will be a promising approach for manufacturing perovskite LEDs. However, recent studies have shown that LEDs produced by vacuum-based deposition exhibit low device performance.

Vacuum deposition provides many advantages over the solution process. It is ideal for deposition all inorganic perovskites because it is free from solubility limitation, as well as conformal coating onto rough substrates. Also, vacuum-based deposition produces highly reproducible and reliable results due to the controllable vacuum preparation environment, which is essential not only for manufacturing but also for building machine learning databases. Vacuum-based deposition has been proven to be the most successful fabrication process for the display industry.

Invention Description

Researchers at Arizona State University have developed a novel class of stable perovskite materials made from co-sublimation deposition that can be used to improve the monochromic and white perovskite-based LEDs with improved device efficiency and operational lifetime. By optimizing the ratio between metal halide and perovskite, the co-sublimated film has been greatly exploited to improve the photoluminescence. The integrated perovskite emissive layer in LEDs enhances the radiative recombination and suppress non-radiative recombination.

Potential Applications

- Display & LED materials
- Solid-state lighting

Benefits and Advantages

- Improved photoluminescence
- Defects-induced nonradiative carrier recombination can be suppressed
- Capability of turning material composition over a broad range
- Enhances radiative recombination
- Can use existing OLED mass production facilities
- Reduces trap density through co-sublimation deposition