有機無機ペロブスカイトを用いる高効率光電変換と高感度光センシング

High Performance Photovoltaic and Photodetecting Devices Enabled by Organic Inorganic Perovskite Crystals

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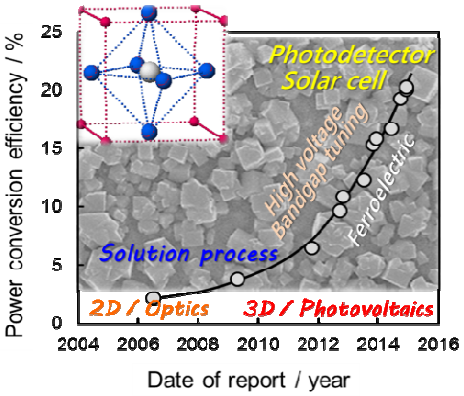
Organo-lead halide perovskite compounds, represented by $CH_3NH_3PbI_3$, exhibit many rare functions as narrow bandgap semiconductors which are superior for photovoltaic power conversion as well as for high gain photon-mode detection of visible light. On the start of our research in 2006, power conversion efficiencies (PCE) of 2.2 %[1a] and 0.4%[1b] were obtained by using $CH_3NH_3PbBr_3$ and $CH_3NH_3PbI_3$, respectively, as an absorber on mesoporous TiO_2. Here, lower value for the iodide was due to poor stability of the iodide perovskite in contact with the organic electrolyte solution. In 2008, this method was improved by making a fully solid state perovskite PV cell with use of carbon-polymer conductive composite as a hole transporter.[2] To date, our group has been tackling the cell fabrication process in ambient air conditions and achieved 17.4% by simple one-step solution process.[3] Here, hysteretic *I-V* behavior, characteristic of the perovskite PV cell, was investigated to clarify its origin(s) and minimize its influence on cell performance.[4] Low temperature process (<120°C) is also applied to perovskite cell fabrication. $CH_3NH_3PbI_3$-based PV achieved PCE close to 14% by using ZnO-coated ITO electrode, by maintaining high stability without encapsulation under ambient air.[5] Such extension of perovskite PV study toward low cost manufacture process is highly promising for future industrialization.

Enormous potential of perovskite-based device is not only expected for solar cells but also for optical sensors. Such pptoelectronic functions of $CH_3NH_3PbI_3$ are also enabled by strong light absorption and long-lived photocarrier for high yield quantum conversion. As a photodiode, gain of $CH_3NH_3PbI_3$-induced photocurrent was found to reach a level of the order of 10^3, showing excellent light-switching and excellent current amplification performance.



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