

Reducing open-circuit voltage loss in organic solar cells

October 17 2019

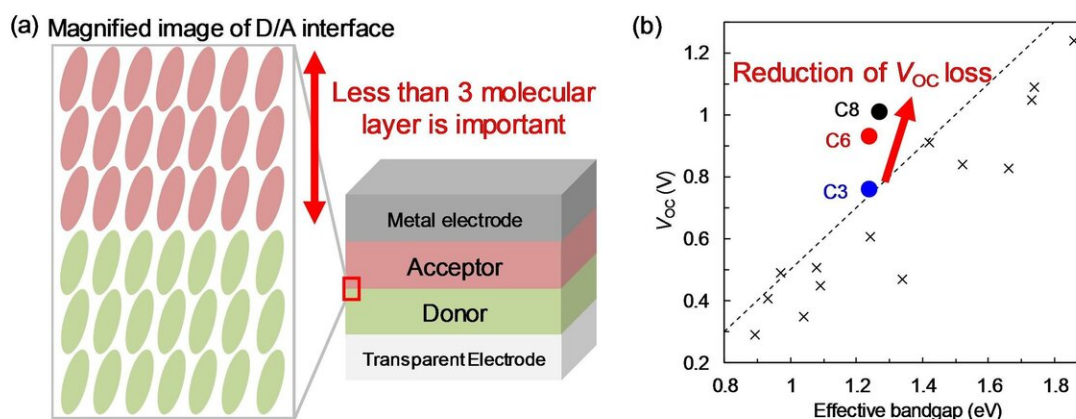


Fig. 1 (a) Schematic image of bilayer OSC devices and magnified image of D/A interface. (b) V_{oc} as a function of effective bandgap in various kinds of OSCs. Credit: NINS/IMS

Researchers at Institute for Molecular Science in Japan report that organic solar cells (OSCs) with high mobility and highly crystalline donor (D) and acceptor (A) materials were able to reduce an open-circuit voltage (VOC) loss. The origin of the high VOC was that the highly crystalline D/A interface reduced the energy loss related to charge recombination. The results demonstrate that careful design of the D/A interface enables high power conversion efficiencies in OSCs.

The power conversion efficiencies of [organic solar cells](#) (OSCs) based on blends of electron donor (D) and acceptor (A) semiconducting materials now exceed 16 percent. However, it is still lower than that of highly efficient inorganic SCs such as GaAs. The charge generation efficiency in OSCs nowadays is nearly 100 percent, thus reducing the energy loss in [output voltage](#) is critically important for further enhancing the efficiency of organic solar cells.

The group of Assistant Professor Seiichiro Izawa and Professor Masahiro Hiramoto at Institute for Molecular Science in Japan report that OSCs with [high mobility](#) and highly crystalline donor (D) and acceptor (A) materials were able to reduce an open-circuit voltage (V_{OC}) loss. Researchers fabricated model bilayer OSCs using these molecules (Fig. 1a). The crystallinity of the acceptor layer could be altered by appropriate selection of the three molecules with different alkyl side-chain lengths. The V_{OC} was found to increase as the crystallinity of acceptor layer increased. The V_{OC} loss was very small comparing to the values of reported OSCs (Fig 1b). The origin of the high V_{OC} was that the highly crystalline D/A [interface](#) reduced the [energy loss](#) related to charge recombination in the output voltage by realizing ideal band-to-band recombination. Especially, the high crystallinity of the several molecular layers (less than 6 nm) in the vicinity of the D/A interface was important for realizing the high V_{OC} . The results demonstrate that careful design of the D/A interface enables high power conversion efficiencies to be achieved in OSCs by reducing open-circuit voltage loss.

More information: Seiichiro Izawa et al, Importance of interfacial crystallinity to reduce open-circuit voltage loss in organic solar cells, *Applied Physics Letters* (2019). [DOI: 10.1063/1.5114670](https://doi.org/10.1063/1.5114670)

Provided by National Institutes of Natural Sciences

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