The impact of intra sub-band tail states on charge carrier trapping and collection in organic solar cells

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1. Introduction: localised tail states

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The burn-in process induced the formation of additional intra bandgap states, causing more severe charge trapping and leading to reduced charge carrier mobility.


3. Impact of tail state density on charge carrier transport

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4. Correlation between \( V_{OC} \) dependence and tail states distribution

Using a charge extraction experiment, a solar cell is held at a certain light and voltage bias before the light bias is switched off at the same time as the voltage is switched to short circuit.

\[
n_{CE} = n_0 \exp(\gamma V_{OC})
\]

\[n_{ave} \propto \exp\left(\frac{E_f}{2E_{ch}}\right),\]

Tail states slope: when \( V_{OC} = E_f \), \( \gamma = \frac{1}{2E_{ch}} \)

5. Photocurrent collection in thick devices

The tail states distribution can be described by exponentially decay towards the bandgap (similar distribution to Gaussian) below the band edge.

\[
N_{CBT} = N_{0CBT} \exp\left(\frac{E - E_C}{E_{chC}}\right)
\]

\[
N_{VBT} = N_{0VBT} \exp\left(\frac{E - E_V}{E_{chV}}\right)
\]

These intra sub-band tail states are functional for charge transport and recombination to different degrees, depend on its density and shape (distribution).

Additional literatures:


