Selectivity is the Essence of Solar Cells

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Solar cells must produce current

E

\gamma

driving forces?

E_c

E_{FC}

E_{FV}

E_v

j_Q
electrons have many handles at which forces can attack

charge:  \[- \nabla (-e\phi)\]  electrical potential

mass:  \[- \nabla m\Psi\]  gravitational potential

particle:  \[- \nabla \mu\]  chemical potential

resulting force:  \[- \nabla (\mu - e\phi) = - \nabla \eta = - \nabla \mathcal{E}_F\]  electrochemical potential
metal contacts are not selective

driving forces are not selective

metal

metal contacts are not selective
Separation of hydrogen and oxygen with selective membranes

driving force: pressure gradient, gradient of chemical potentials
Separation of electrons and holes by selective conductivities in front of metal contacts.
optimal hetero-structure ($E_G = 1.34 \text{ eV}$) 
full area contacts at maximum power


$V_b = 697 \text{ mV}, \ V_{mpp} = 987 \text{ mV}$

$\eta = 33.7\%$
realisation in organic solar cells
PTAA / perovskite / C60

simulation by U. Wuerfel, Fraunhofer ISE