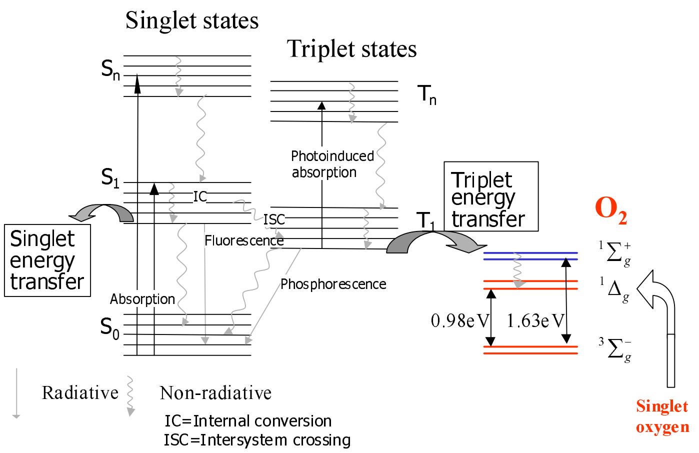
# Environmental stability of the chemical structure

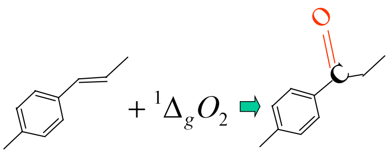
**Singlet Oxygen Sensitization Via the polymer Triplet state**

**Polymer**

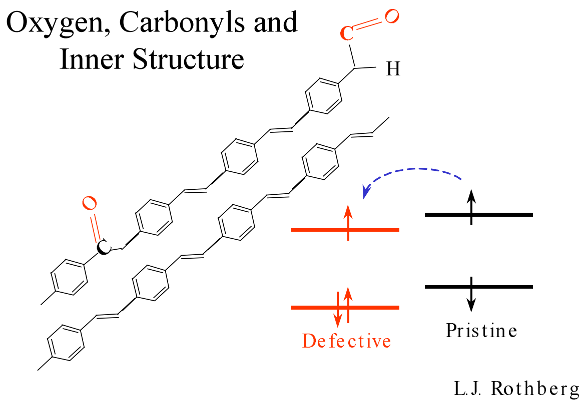



See also: B. H. Cumpston and K. F. Jensen, Synthetic Metals **73** (3), 195 (1995); B. H. Cumpston, I. D. Parker, and K. F. Jensen, Journal of Applied Physics **81** (8 Pt1), 3716 (1997)

## Formation of carbonyl groups




## Chemical defects = dissociation centers, traps




## Intercepting the oxidation


[1] V. Cleave, G. Yahioglu, P. LeBarny, R. H. Friend, and N. Tessler, "Harvesting singlet and triplet energy in polymer LEDs," *Advanced Materials*, vol. 11, pp. 285-288, 1999.

[2] G. D. Hale, J. B. Jackson, O. E. Shmakova, T. R. Lee, and N. J. Halas, "Enhancing the active lifetime of luminescent semiconducting polymers via doping with metal nanoshells," *Appl. Phys. Lett.*, vol. 78, pp. 1502-1504, 2001.

## Environmental stability of electronic conductivity (doping)

(D. M. Leeuw, M. M. J. Simenon, A. R. Brown, R. E. F. Einerhand, Synth. Met. 1997, 87, 53)

***Instability of N type towards oxygen (or tendency of intrinsic to become P type)***

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$   $E = -V_1$

$2Pol^0 + 2e^- \leftrightarrow 2Pol^-$   $E = -V_2$

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$4Pol^- + O_2 + 4H^+ \leftrightarrow 4Pol^0 + 2H_2O$   $E = -V_1 - (-V2)$

***Instability of N type towards water (or tendency of intrinsic to become P type)***

$2H_2O + 2e^- \leftrightarrow H_2 + 2OH^-$   $E = -V_3$

$2Pol^0 + 2e^- \leftrightarrow 2Pol^-$   $E = -V_2$

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$2Pol^- + 2H_2O \leftrightarrow 2Pol^0 + H_2 + 2OH^-$   $E = -V_3 - (-V2)$

The value of $V_2$ depends on the specific polymer however, for most (all?) polymers it is such that N type is not chemically stable. ⇒ Encapsulate devices. [a dense material that does not allow penetration (diffusion) of oxygen and water will show better stability but probably still require encapsulation to be truly stable]