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Electron processing at low energies: from basics to environmental and biological applications.[1]

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Electron initiated reactions play a key role in nearly any field of pure and applied sciences, in the gas phase as well as in condensed phases or at interfaces. This include substrate induced photochemistry, radiation damage of biological material (and, accordingly, the molecular mechanisms, how radio sensitizers used in tumour therapy operate), reactions induced by electrons in surface tunnelling microscopy (STM), or any kind of plasma used in industrial plasma processing. In each of these fields the electron-molecule interaction represents a key step within an eventually complex reaction sequence. A particularly interesting field is the interaction of electrons with molecules at energies below the level of electronic excitation. In this range many molecules exhibit large cross sections for resonant electron capture, often followed by the decomposition of the transient negative compound ($M^{-\#}$) according to $e^- + M \rightarrow M^{-\#} \rightarrow R + X^-$. We report on such dissociative electron attachment (DEA) processes studied at different stages of aggregation, namely in single molecules under collision free conditions, in clusters formed by supersonic gas expansion, and on the surface of solids or in molecular nanofilms. In the meantime it has also been recognised that in the damage of living cells by high energy radiation the attachment of low energy secondary electrons to DNA is a key initial process leading to strand breaks. These secondary electrons are created along the ionisation track of the primary high-energy quantum. Apart from that, bio-molecular systems exhibit unique features in DEA, like bond and site selective decompositions.

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