Charge transport through a molecular π-stack: double helical DNA

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Abstract

Double helical DNA, containing a π-stacked array of base pairs within its interior, can be considered as a molecular analogue of solid state π-stacked arrays. Like the solid state materials, the DNA base pair stack provides a medium to facilitate charge transport. However, owing to the dynamical motions of the base pairs within the molecular stack, as well as sequence-dependent inhomogeneities in energetics and base–base couplings, DNA charge transport differs considerably from that in solid state π-stacked materials. Here we review some of the experimental techniques and chemical assemblies used to probe charge transport in DNA. We focus on those parameters that distinguish charge transport within the molecular base pair stack and highlight the sensitivity of DNA charge transport to dynamical variations in base stacking and couplings. Exploiting the sensitivity of DNA charge transport to these sequence- and structure-dependent variations in stacking provides a route to the design of DNA-based nanoscale sensors. Certainly the application of DNA in molecular electronic devices must take into consideration those factors that promote and inhibit DNA-mediated charge transport