

PHOTOPHYSICAL PROPERTIES AND ELECTRON TRANSFER REACTIONS IN FULLERENE[C60] AND A FEW OF ITS DERIVATIVES

Jai P. Mittal

Chemistry Group, Bhabha Atomic Research Centre, Mumbai 4000 085

Abstract: In recent years the buckminsterfullerene, fullerene[C60] has shown very promising applications in nonlinear optics and optoelectronics, photovoltaic cells and also in biology. Hence fullerene chemistry is being well developed with the synthesis of new derivatives by attachment of different functional groups onto it as well as their studies of photophysical and photochemical properties since in all of the applications mentioned above the different excited states are responsible for the required actions. The physicochemical properties of the fullerene derivatives show considerable differences from those of their pristine because of the perturbation of the π -electron distribution on the surface of the spherical surface of the molecule and hence change in the sp^2 character of the C – C bonds. In the present talk we will discuss about a few of the important photophysical properties and electron transfer reactions of the fullerene[C60] and a few of its substituted pentaphenyl derivatives.

The photophysical properties of the singlet and triplet states of the three aryl-substituted derivatives of C₆₀, are closely comparable, but are quite different to those of C₆₀. The sharp absorption bands of C₆₀, in the ground state, are broadened by the presence of the functional groups. The lifetime of the singlet state remains nearly the same (1.5 ns), but the visible band (480 nm) of the C₆₀ singlet state shows a red shift to 610 nm in these derivatives. The near infrared absorption band (890 nm) remains unchanged. The near infrared absorption band (740 nm) of the triplet state of C₆₀ is blue shifted to ca 650 nm in these two derivatives. The quantum yields and the lifetimes of the triplet states are shown to decrease on addition of the functional groups to C₆₀. It may therefore be concluded that the photophysical properties of the singlet and triplet states and also of the ground state are significantly affected by the presence of the addends. The electron transfer properties of the two substituted fullerene derivatives have also been investigated. They form weaker complexes and show weaker charge transfer activities with the aromatic amines as compared to C₆₀. In benzene the interaction is so weak no indication of complexation has been obtained. Hence the electron transfer reactions for these fullerene derivatives have been investigated in more polar solvent, benzonitrile, and are very similar to those of C₆₀.