# Langmuir-Blodgett Films of the Endohedral Metallofullerene Dy@$C_{82}$ Mixed with Metallophthalocyanine and Their Photoelectrochemistry

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Endohedral metallofulerenes represent a novel type of super-atom molecules, which is characterized by a robust fullerene cage with metal atoms trapped in its hollow (1,2). The encapsulation of the metal atoms brings about many additional and desirable properties such as peculiar redox behavior, radioactivity, luminescence, paramagnetism, and enhanced nonlinear optical response. In recent years, great efforts have been made on the studies on the langmuir film formation behavior and the photoelectric conversion of metallofullerene Dy@$C_{82}$ (3,4).

In the present work, monolayer and multilayer Langmuir-Blodgett (LB) films of the endohedral metallofullerene Dy@$C_{82}$ mixed with metallophthalocyanine (MPc) were fabricated from the $N_2$/water interface. Tetrasubstituted [tsCuPc=Cu(II) tetra-*tert*-butyl-phthalocyanine] and octasubstituted [osMPc=M(II) octakis(octyloxy)-phthalocyanine (M=Cu or Zn)] MPcs with long alkyl side chains, which are among the most popular target molecules due to their highly desirable chemical and physical properties (5), were chosen for these studies. Langmuir film formation behavior of Dy@$C_{82}$/MPc was found to be dependent on the substituent and central metal ion as shown in Fig. 1.

The photoelectrochemical response of the Dy@$C_{82}$/MPc LB films on ITO was investigated. Stable anodic photocurrent responses were observed for all the three mixture films with enhanced quantum yields compared to that of pure Dy@$C_{82}$ (4), while the octasubstituted MPcs exhibit much better performance than the tetrasubstituted one. This is explained by the facile photo-induced charge transfer taking place between Dy@$C_{82}$ and the octasubstituted MPcs as inferred by UV-Vis characterization (Fig. 2). The effects of bias voltage, light intensity, electron donor were studied in detail. Possible mechanism for the photocurrent generation is discussed.

## ACKNOWLEDGEMENTS

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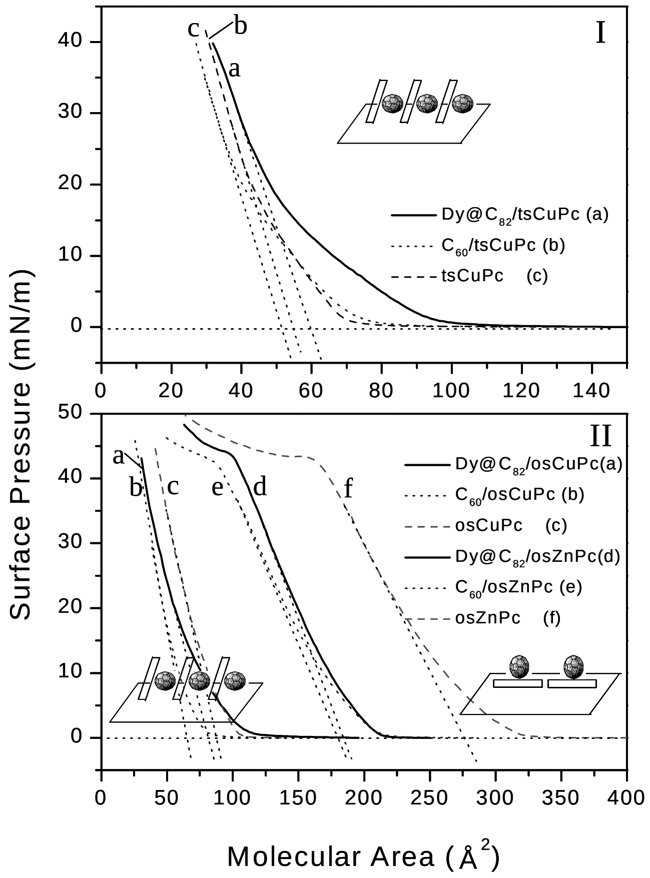

*Fig. 1* Surface pressure – area (π-A) isotherms of Dy@$C_{82}$/MPc, $C_{60}$/MPc and pure MPc at the $N_2$/water interface, pH = 6.5. The barrier compression speed is 2 cm·min$^{-1}$ The insets illustrate the possible structures of the mixture langmuir films. The elongated balls are the metallofullerenes and the blocks are MPc molecules.

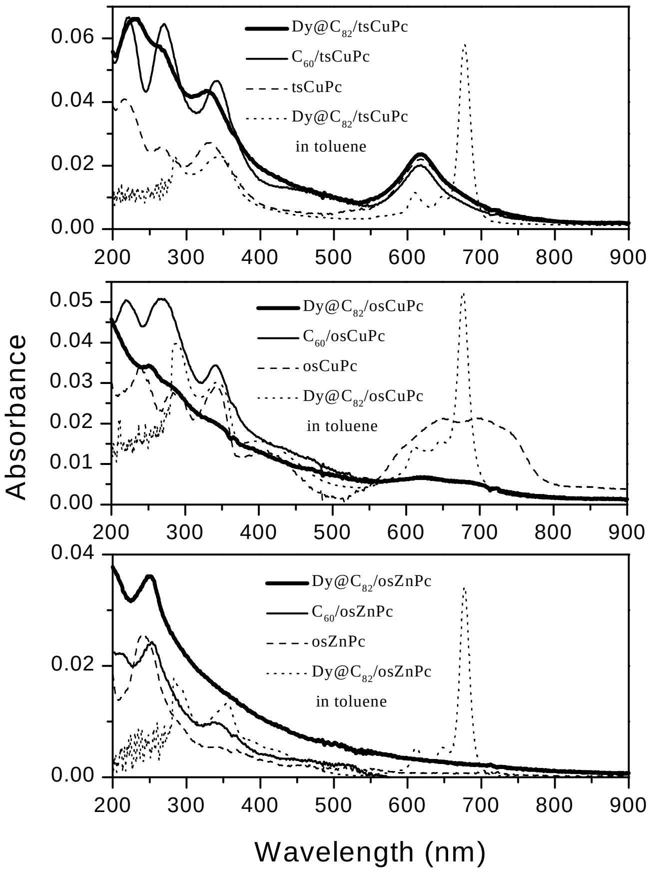

*Fig. 2* UV-Vis absorption spectra of the Dy@$C_{82}$/MPc LB films on the quartz plates. The spectra of the Dy@$C_{82}$/MPc (1:1) mixtures dissolved in toluene are also shown as references (dotted line).