Electrochemical and Chemical Reduction Properties of Fullerenes C_{60} and C_{70} Embedded in Cast Films of Cationic Lipid

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The chemistry of fullerene anions is among the most fundamental in the field of fullerene science. 1 The monoanions of fullerenes have been generated by chemical reducing agents as well as electrochemical methods.2 Most of these studies were examined in organic homogeneous solutions, since the generation of fullerene anions in aqueous solutions is difficult due to their kinetic instability. No report has been published describing the chemical generation of fullerene anions in films on substrates in water. We have recently described stable electrochemistry at C_{60}/cationic amphiphile-modified electrodes in aqueous systems.3 Naqiang Li et al. have published the electrochemistry of C_{60} embedded in the cationic di-n-dodecylmethylammonium bromide film in aqueous solution.4 We describe here the generation of C_{60}− and C_{70}− using Na_{2}S_{2}O_{4} as a reducing agent acting upon C_{60} or C_{70} embedded in cationic amphipathic matrix films on quartz plates in aqueous media by means of vis–near IR spectroscopy.

In this work, C_{60} and C_{70} were embedded in thin films of amphiphiles on quartz plates. The matrix lipids used were: tridodecylmethylammonium bromide (3C_{12}NBr),5 tetraoctylammonium bromide (4C_{8}NBr) 3 , tetraoctylphosphonium bromide (4C_{8}PBr) 3, didodecylglycerol (2C_{12}Gly) and didodecyldiphasphate (2C_{12}PO_{4}H), which are shown in Figure 1.

Figure 1. Chemical structures of matrix lipids.

Experimental Section. The procedure for preparing a cast film on a quartz plate is as follows. A 300 microliter portion of C_{60} or C_{70}lipid (molar ratio, 1/19) in toluene ([C_{60}] or [C_{70}]= 0.5 mM) was placed on a quartz plate, and then air-dried. Vis–near IR absorption spectral measurements for the modified quartz plate were carried out in Milli-Q water for C_{60} and in D_{2}O for C_{70} in the absence or the presence of Na_{2}S_{2}O_{4} as a reducing agent at 25 °C under an argon atmosphere.

Figure 2. NIR absorption spectra for a cast film of C_{60}/3C_{12}NBr (molar ratio, 1/19) on a quartz plate in water in the absence or the presence of Na_{2}S_{2}O_{4} under Ar.

References: