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Synergistic Processes At Optically-Active Membrane-Protein, Conducting Polymer Interfaces

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Bacteriorhodopsin (bR), a protein existing in the halobacterial purple membrane serves as a light driven pump which sets up an electrochemical gradient and transports protons across the cell membrane. We have explored the synergetic processes at the conducting polymer/bR interface due to photoexcitation in presence of a voltage bias. Several interesting features in the photoelectric signal characteristics are observed from systems consisting of oriented-bR films on conducting polymer substrates. The possibility of changing the oxidation state of the polymer electrochemically is coupled to the optically-activated proton gradient in the bR side in this unique hybrid system. It was recently demonstrated that the internal conversion of the intermediate deprotonated M state of bR and the proton transfer/transport can be controlled by the electrochemical reactions at the adjacent poly(3,4-ethylenedioxythiophene) poly(styrene sulfonate) layer and leads to interesting device prospects in the process.[1,2] We generalize the principles involved by studying variety of mutant forms of bR and conducting polymers with different doping levels. The implications of coupling the biophysical events in bR with the electrochemical processes of the conducting polymer in terms of interesting wavelength- dependent photodiode features and photo-electrochemical transistor action will be discussed.

1. A. G. Manoj and K. S. Narayan, Appl. Phys. Lett., 83, 3614 (2003).
2. A. G. Manoj and K. S. Narayan , Biosens. and Bioelectr. J., 10, 967 (2004).