Development of thin film of purple membrane

Bacteriorhodopsin is a stable trans-membrane protein of *Halobacterium*, prefers to live in salt marshes and can survive even in bizarre environmental conditions enabling its biological components for technological development. One of such components is retinal proteins from *Halobacterium* which is configured into a seven-transmebrane helix (named as A, B, C, D, E, F and G) topology with short interconnecting loops. The helices are arranged into arc-like structure tightly surrounding a retinal molecule that is covalently bound via a Schiff base to a conserved lysine (Lys-216) on helix G. Retinal separates a cytoplasmic surface from an extra cellular half channel that is lined by amino acids crucial for efficient proton transport by bR (especially Asp-96 in the cytoplasmic and Asp-85 in the extracellular half channel). The Schiff base between retinal and Lys-216 is located at the center of this channel. For proceeding vectorial proton transport, de- and re-protonation of the Schiff base must occur from different sides of the membrane. Thus, the accessibility of the Schiff base for Asp-96 and Asp-85 must be switched during the catalytic cycle. The geometry of the retinal, the protonation state of the Schiff base, and its precise electrostatic interaction with the surrounding charges (Asp-85, Asp-212, Arg-82) and dipoles tune the absorption maximum to fit its biological function. Fast photochemistry, stability in both light and dark adopted configuration along with these structural features make this material as national need for technological innovation covering molecular devices, molecular sensors and biosensotized solar cell.

Since the discovery of bR in early 1970s the conceptual simplicity and experimental advantages of bacteriorhodopsin have made this light-driven proton pump a testing ground for hypotheses of transport mechanisms and new experimental technologies. Apart from such a tremendous potentiality of this biomolecule, human made devices involving the power of rhodopsin has been one of the greatest attraction during last decade and outcomes have shown the possibility of generating nano devices, e.g., (a) material for optical information recording, (b) molecular sensors, (c) electronic switches, (d) gates, (e) biological transistors, (f) artificial retina. Research on the photo-electrochemistry of bacteriorhodopsin (BR) has been of great significance due to its variety of practical applications ranging from molecular recognition to molecular electronics. The group of Prof P C Pandey at IIT(BHU) has been working on bR-based design since 1992 specifically on the sensing of proton donors and proton acceptors present in extra-cellular medium based on bR- spectrophotometry [Sens. Actuators B 35–36 (1996) 470–474; Sens. Actuators B 46 (1998) 80–86]; photoelectrochemistry of bR yielding forward and backward photo-currents [Sens. Actuators B56 (1999) 112–120], stabilization of bR in thin film of silicate [J. Sol–Gel Sci. Technol. 33(2005) 51–58; *Anal. Chimica Acta 568 (2006) 47–56].* Pandey group developed organically modified silicate encapsulated bR film by gravity settling technology. Such film yielded better loading of PMs; however, the reactivity of organic functionalities interrupted the conformation of retinal that altered the photochromic property of purple membrane (PMs). Apart from tremendous need of purple membrane as molecular electronic materials, the availability of the same as homogeneous suspension or in thin film preparation was limited to mostly German or Russian vendor. Accordingly the, task for isolating the purple membrane from Halobacterium and the development of thin film of the same was assigned to Prof Pandey group. During short tenure of 2 years, the task was completed with full details published in Appl Biochem Biotechnol, 168(2012)936-946 and in the form of an Indian Patent 3894/DEL/2011.