This talk is an attempt to throw some light into the nanoscale aspects of biological phenomena. Movement of metabolites and various non-bound organelles is governed by anomalous subdiffusion inside the cell. Impact of high frequency perturbations upon the electrochemical impedance will be discussed, showing an increase in the impedance with increasing frequency as in skin-effect. Cell membranes and microtubules play an important role in maintaining cell shapes, which get affected to a great extent by the amount of surface tension on the lipid bilayer membrane. One of the reasons that surface tension on the membrane might vary, other than the varying turgidity of cytoplasm and extracellular matrix, is the adsorption of metabolites during ingestion, excretion or intracellular trafficking. A model incorporating anomalous subdiffusion based Langmuir adsorption phenomenon has been developed, which shows the dynamic adsorption behaviour for different values of diffusion exponents. This dynamic adsorption behaviour then directly translates to the instantaneous surface tension developed in the cell membrane as well as microtubules.

Microtubules have been conjectured to possess piezoelectric properties. A theoretical model that involves buckling of microtubules due to several forces acting on it has been developed. In addition to the cytoskeletal forces, effect of buckling due to thermal fluctuations caused by dynamic instability has also been studied. Piezoelectric potential generation due to such buckling forces has been studied. A hypothesis has been put forth describing the communication in intracellular microtubules' network in terahertz (THz) frequency mode.

Electrical behaviour of microtubules has been studied by application of constant potential over longer periods of time a.k.a. chronoamperometry in dry phase. It has been observed that the currents first decrease to the minimum detectable value i.e. $\sim 10^{-13}$ A within a period of 800 seconds. This time was fixed as cycle time. During subsequent cycles, a higher potential was applied marked by an increase in the current values till certain time after which it started decreasing. Qualitative reasoning for such an observation is provided using Nernst-Planck-Poisson equation (for decreasing trends) and stretching of proteins (for increasing trends).

Presence of magnetic domains was checked in drop-casted and dried MAP-rich tubulin on a quartz substrate using magnetic force microscopy. Such domains were reasoned to exist because of the Freedericksz transition of the director axis of nematic liquid crystalline microtubules, from a uniform to a deformed director axis configuration.

Anti-Stokes scattering was observed in MAP-rich tubulin in liquid phase. This scattering has been explained by the nematic liquid crystalline property of microtubules. Optical bandgaps, direct and indirect, were measured in liquid phase with the help of a spectrophotometer using Tauc plot technique. Since the indirect bandgap value was lesser than the direct one, it has been concluded that microtubules act as an indirect bandgap semiconductor.

These studies, theoretical as well as experimental, make an attempt to elucidate the nanoscale phenomena that govern various aspects of biological systems. It would help us in understanding these systems in a better way.