Synopsis

Thesis Title: "Modelling and Fabrication of Proteotronic Devices for Various Electrical and Optical Applications". **(Index no:** 72/21/Phys./27 of 2021)

In the contemporary era characterized by the widespread use of cellular phones, laptops, tablets, and electric vehicles, the significance of charge storage devices cannot be overstated. These devices play a crucial role in ensuring the availability of dependable and efficient energy sources. Due to the swift progress in charge storage technology, there is a need for frequent updates of storage devices. Consequently, this trend raises concerns regarding the future availability of raw materials required for the fabrication of such devices. The accumulation of not-so-old and underutilized electronic gadgets has led to the generation of electronic waste (e-waste), which has been shown to surpass a yearly total of 50 million tons. The mitigation of the environmental dilemma necessitates a reliance on organic electronics, which have been shown to produce significantly less waste in comparison to their inorganic counterparts. Organic electronics provide several advantageous characteristics, including but not limited to flexibility, bio-compatibility, non-toxicity, and both ionic and electrical conductivity. These attributes render them very suitable for integrating electronic components into biological systems.

This dissertation aims to elucidate the integration of proteins into dielectrics and electronic substrates, as well in photoactive devices. The primary objective of this study is to investigate the dielectric properties of proteins derived from both plant and animal sources. The study also aims to gain a comprehensive understanding of the underlying mechanisms involved in charge transport channels through proteins. Animal protein bovine serum albumin and plant protein papain has been used to fabricate different charge storage devices. These two proteins have shown favourable characteristics in terms of charge storage and resistive switching. The animal based protein has also been employed in photoactive device fabrication, and it showed considerable photo-response. In addition, we have proposed a completely organic, transient, soluble, transparent, and environmentally degradable substrate as the starting material for the fabrication of electronic devices. The substrate composed of a protein biopolymer obtained from gelatin exhibited good mechanical and morphological characteristics, rendering it suitable for the fabrication of electronic devices. Hence, this study aims to stimulate interdisciplinary discussions and research on topics such as bio- and bio-inspired electronics, with a focus on the potential of future implanted biocompatible integrated circuits and innovative healthcare applications.

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