

## Investigation on the Interaction Mechanism Among Various Soft System

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### ABSTRACT

This thesis explores the interaction mechanisms involved among various soft matter systems that are highly relevant to nanotechnology, biotechnology, and pharmaceutical sciences. Key systems examined include graphene oxide (GO)-dye-surfactant assemblies, protein-bile salt interactions, ionic liquid (IL)-based vesicular systems with proteins, drug-surfactant interactions, and graphene/reduced graphene oxide (RGO)-protein complexes. The unique two-dimensional structure and  $\pi$ -conjugated system of GO allow for efficient fluorescence quenching of dye molecules, with surfactants influencing this process by preventing non-specific binding and aggregation. These interactions are essential for developing advanced optical sensing platforms. The study also highlights the role of bile salts as biosurfactants that interact with proteins, affecting physiological processes and enabling uses in drug delivery, proteomics, and pharmaceutical formulations. Surface-active ionic liquids (SAILs), which combine the properties of surfactants and ionic liquids, are examined as versatile and environmentally friendly carriers for proteins and drug compounds because of their amphiphilic and biocompatible characteristics. Mixed micellar systems composed of drugs and surfactants are studied for their ability to improve drug solubility, decrease toxicity, and facilitate targeted delivery. Additionally, the interaction of graphene-based nanomaterials with biological molecules is evaluated to determine their potential in biomedical applications, especially in drug delivery and biosensing. The results presented aid in the rational design of multifunctional soft systems for use in emerging nanobiotechnological and pharmaceutical fields.

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