MULTIFUNCTIONAL NANOCOMPOSITES: SYNTHESIS AND ANTIOXIDANT ACTIVITY ASSESSMENT IN COLLOIDAL DISPERSIONS

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My project focused on the development of nanocomposites with the ability to mimic antioxidant enzymes.

Abstract

In our environment, there are various highly reactive molecules and ions that can harm both living organisms and industrial products. In living organisms, there are natural defense mechanisms against these harmful substances, including a network of antioxidant enzymes. These enzymes help break down reactive oxygen species (ROS) – which are particularly damaging – therefore they play a crucial role in preventing and treating conditions associated with high ROS levels.

However, these natural enzymes are expensive to produce and they can lose their activity due to small changes in environmental conditions thus there is a growing need for alternatives. Enzyme-mimicking nanoparticles, i.e., nanozymes, represent a promising alternative due to their low-cost preparation, high durability and tunable physicochemical properties.

Our work focuses on the development of multicomponent materials – composites – with enzyme-like activity. Specifically, we used manganese(IV)-oxide (MnO_2) and cerium(IV)-oxide (CeO_2) nanoparticles, which are known to mimic multiple antioxidant enzymes, such as catalase and superoxide dismutase. Taking into account the conditions under which these nanoparticles operate, we modified their surface charges by attaching a positively charged polymer. This change in surface charge allowed us to create two different composite materials through the principles of electrostatic attraction. Both composites proved to be remarkably stable as well as able to mimic several antioxidant enzymes, making them promising nanomaterials to be explored in various fields where antioxidants are required.