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Silver nanomaterials in the natural environment: An overview of their biosynthesis and kinetic behavior

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摘要

Silver nanomaterials (Ag NMs) are fabricated by many biological components in our environment. Recently, research on their biosynthesis and reactions has become a focus of attention. Due to the complexity of biological systems and samples, specific processes and mechanisms involving Ag NMs are difficult to identify and elucidate on the molecular and chemical-bond level. The microorganisms and composite components of plant extracts are of great interest in many biological syntheses. Although potential biomolecules have been shown to play essential roles in biological systems in Ag NM biosynthesis, the detailed mechanism of the electron transfer process and crucial molecules that control this reaction have only recently come into focus. The reactive behavior of the Ag NMs is of great significance for understanding their overall behavior and toxicity. Additionally, only limited knowledge is available about their kinetics.

All reactions involve chemical bond formation, electron transfer, or electrostatic interactions. An overview is presented of the biosynthesis of Ag NMs based on molecular supports including a nitrate reductase/NADH oxidase involved electron transfer reaction and their mechanisms in Ag⁺ reduction: quinol-mediated mechanism and superoxide-dependent mechanism, and molecular supports in plant extracts, is presented. The environmental reaction kinetics and mechanisms of the interactions of Ag NMs with substances are introduced based on the formation and classification of chemical bonds. The particle-particle reaction kinetics of Ag NMs in the environment are discussed to directly explain their stability and aggregation behavior. The toxicity of Ag NMs is also presented. In addition, future prospects are summarized. This review is the first to provide an insight into the mediating molecules and chemical bonds involved in the biosynthesis, kinetics, and mechanisms of action of Ag NMs. (C) 2018 Elsevier B.V. All rights reserved.

关键词

作者关键词: Biosynthesis; Silver nanomaterials; Mechanism; Reaction; Kinetics

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