Green synthesis of nanoparticles

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Abstract

There are many definitions for nanotechnology and nanomaterials due to their multidisciplinary nature. The general definition of nanomaterials is that the structures have at least one dimension in the range of 100 nm or smaller. The definition for nanotechnology is that it is a discipline to investigate the production, manipulation, design, and engineering of nanomaterials. The use of nanomaterials has been spread in a large palette of applications such as energy, optics, electronic and medicine. Nowadays the state of the art nanoscience is capable of producing many multifunctional materials, however they have shortcomings such as using hazardous chemicals, methods being complicated and cost intensive and lack of scalability. In order to eliminate this shortcomings green synthesis techniques have been evolved recently.

Green syntheses are environmental friendly alternatives to conventional synthesis techniques. They aim to reduce toxic elements used or produced in conventional methods. Moreover, they benefit from sustainable sources and can reduce production cost, in practical and up-scalable manner.

In this thesis we focus on two different green synthesis techniques. In our first technique, silver/gold plasmonic bionanocomposites (BNCs) as well as 3D bio-shells decorated with BNCs are produced using natural products in a biogenic fashion. In such techniques biomolecules such as enzymes, proteins, bacteria, fungus, yeast, and plant biomasses, are used to produce nanoparticles. The produced particles are highly promising for biological applications due to their biocompatible nature.

Our second technique is based on Leidenfrost phenomenon where Leidenfrost dynamic chemistry occurring in an underwater overheated confined zone is used as a smart, versatile and a quick way of zinc peroxide nanoparticle production. The produced particles are then investigated in terms of cytotoxicity effect on cancer and healthy cells to prove their applicability as cancer nanotherapeutics.