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Robust Synthesis of Size-Dispersal Triangular Silver Nanoprisms via Chemical Reduction Route and Their Cytotoxicity

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Abstract: Triangular silver nanocrystals, well-known as nanoprisms (Ag-NPrs), were successfully developed via a robust and straightforward direct chemical reduction synthetic approach, producing desirable tiny and well-controlled Ag-NPrs. This procedure was accomplished by fabricating a mixture of di-sodium succinate hexa-hydrate (DSSH) and tri-sodium citrate di-hydrate (TSCD) as capping agents at optimal synthetic conditions and under an open-air condition, which proved to be an enormous challenge. Additionally, the Ag-NPrs were fully characterized by UV-vis spectra, X-ray diffraction (XRD), scanning electron microscope (SEM), and dynamic light scattering (DLS). Likewise, the formation stages from spherical silver nanoparticles (Ag-NPs) to triangular Ag-NPrs were also captured simultaneously via transmission electron microscope (TEM) and high-resolution transmission electron microscope (HR-TEM) images. More interestingly, an active thin silica-shell was efficiently applied on the Ag-NPrs outer-layer to increase their functionality. Furthermore, to confirm their biocompatibility, we also carried out cell viability assays for the Ag-NPs, Ag-NPrs, and Ag-NPrs@SiO_2 with different concentrations at 62.5, 125, and 250 µg/mL after 12, 24, and 48 h of exposure time, respectively, on a regular African green monkey kidney cell line. The cell viability test results exemplified that the three silver nanostructures were toxic-free and suitable for further potential biological applications in the near future.

Keywords: direct chemical reduction; silver nanoparticles; nanoprisms; silica coated nanoprisms; cell viability assay

1. Introduction

Noble metal nanoparticles have received considerable attention over the past decade because of their exceptional chemical, optical, and electronic properties [1]. The previously mentioned assets have made them competent to be promoted by many remarkable applications in diverse research arrays, such as catalysis process [2], biological and chemical sensing [3,4], optics [5], and Surface-Enhanced Raman Spectroscopy (SERS) [6]. Since the fabrication of different shapes of metallic nanostructures has increased throughout the last few years, many routes have been swiftly developed to yield these magnificent two-dimensional (2D) structures, such as disks [7,8], rods [9], wires [10,11], and nanoprisms [12,13]. Lately, researchers have paid much attention to the synthesis and optical characterization of triangular silver nanoprisms (Ag-NPrs) or plates as they have excessive biological