Synthesis of Ultrathin Silver Nanorods and Enhancing Their Stability in Biofluids

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Abstract
Silver nanorods are commonly believed to exhibit better optical performance comparing to their gold counterparts. However, in the past two decades, they have received much less attention than gold nanorods in the field of plasmonics and related interdisciplinary fields. A main drawback for practical applications of silver nanorods is the poor chemical and structural stability. In particular, the toxicity of silver ions, as a result of silver degradation, largely hinders their applications in biological analytics based on cell cultures. Another drawback is a lack of facile synthetic methods, especially for thin silver nanorods with diameters below 20 nm. We herein report a robust synthetic method for the preparation of ultrathin silver nanorods with controllable diameters of 10–20 nm and widely tunable lengths ranging from a few tens of nanometers to several micrometers. Penta-twinned gold nanoparticles are used as seeds to direct the growth of silver nanorods.[1,2] Depending on the sizes of the gold seeds, symmetric or asymmetric nanorods can be obtained due to a size dependent effect of heterogeneous/homogeneous silver overgrowth. These ultrathin silver nanorods possess a number of attractive features, including highly tunable plasmon wavelengths, intensive local field enhancement, outstanding dimensional uniformity, narrow plasmon bands, excellent photo-thermal conversion ability, and promising sensing performance. Furthermore, they are demonstrated to be stable and noncytotoxic after coating with a thin layer of polymer, where Raman molecules and dye molecules can be also facilely loaded inside. Intracellular surface-enhanced Raman scattering (SERS) imaging and surface-enhance fluorescence imaging are performed as examples for demonstrating the potential applications and outstanding performance of the ultrathin silver nanorods.

References

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Figures

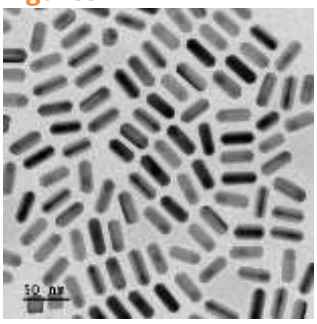

Figure 1. Representative TEM image of the ultrathin silver nanoords.