Green preparation and spectroscopic characterization of plasmonic silver nanoparticles using fruits as reducing agents

Chemicals typically available in plants have the capability to reduce silver and gold salts and to create silver and gold nanoparticles. We report the preparation of silver nanoparticles with sizes between 10 and 300 nm from silver nitrate using fruit extract collected from pineapples and oranges as reducing agents. The evolution of a characteristic surface plasmon extinction spectrum in the range of 420 nm to 480 nm indicates the formation of silver nanoparticles after mixing silver nitrate solution and fruit extract. Shifts in plasmon peaks over time indicate the growth of nanoparticles. Electron microscopy shows that the shapes of the nanoparticles are different depending on the fruit used for preparation.

The green preparation process results mainly in individual nanoparticles with a very poor tendency to form aggregates with narrow gaps even when aggregation is forced by the addition of NaCl. This explains only modest enhancement factors for near-infrared-excited surface enhanced Raman scattering. In addition to the surface plasmon band, UV-visible absorption spectra show features in the UV range which indicates also the presence of small silver clusters, such as Ag42+. The increase of the plasmon absorption correlates with the decrease of absorption band in the UV. This confirms the evolution of silver nanoparticles from silver clusters.

The presence of various silver clusters on the surface of the "green" plasmonic silver nanoparticles is also supported by a strong multi-color luminesce signal emitted by the plasmonic particles during 473 nm excitation.

General information
State: Published
Organisations: Department of Micro- and Nanotechnology, Department of Physics, Biophysics and Fluids, Fluidic Array Systems and Technology, Technical University of Denmark
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Pages: 293-299
Publication date: 2015
Peer-reviewed: Yes

Publication information
Journal: Beilstein Journal of Nanotechnology
Volume: 6
Issue number: 1
ISSN (Print): 2190-4286
Ratings:
Web of Science (2019): Indexed yes
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 3.32 SJR 1.119 SNIP 1.233
Web of Science (2017): Impact factor 2.968
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.66 SJR 1.138 SNIP 1.026
Web of Science (2016): Impact factor 3.127
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 1
Scopus rating (2015): CiteScore 3.05 SJR 1.001 SNIP 0.944
Web of Science (2015): Impact factor 2.778
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): CiteScore 2.67 SJR 1.163 SNIP 1.038
Web of Science (2014): Impact factor 2.67
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 1
Scopus rating (2013): CiteScore 2.56 SJR 1.268 SNIP 1.057
Web of Science (2013): Impact factor 2.332
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
Scopus rating (2012): CiteScore 2.01 SJR 1.036 SNIP 1.004
Web of Science (2012): Impact factor 2.374