Electronic Supplementary Material (ESI) for Nanoscale

Supplementary Information for

Aerosol-seed-assisted hybrid chemical route to synthesize anisotropic bimetallic nanoparticles

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Spark generation: A spark was formed between two identical gold rods (diameter: 3 mm, length: 100 mm, AU-172561, Nilaco, Japan) inside a chamber under a pure nitrogen environment (>99.99% purity) at standard temperature and pressure. The flow rate of the nitrogen gas was controlled by a mass flow controller (3660, Kofloc, Japan). The electrical circuit specifications were as follows: resistance 0.5 MΩ, capacitance 1.0 nF, loading current 0.3 mA, applied voltage 3.0 kV, and frequency 300 Hz.

Reaction solutions: The silver precursor solution was a mixture of solutions 1 and 2 at a 1:5 (v/v) ratio. 85 mg of silver nitrate (SN, 99.9 %, Aldrich), used as a precursor of silver, was dissolved in 5 mL of deionized water (DW) (Solution 1). Ethylene glycol (EG, 99.9 %, Aldrich, US) was used as a reduction agent (Solution 2). Solutions 1 and 2 were injected with the aid of a peristaltic pump (323Du/MC4, Watson-Marlow Bredel Pump, US) at constant rates of 0.42 and 2.08 mL min^{-1}, respectively.

Ultrasound application: The probe acted as an ultrasound irradiator (VCX 750, 13 mm titanium alloy horn, 20 kHz, Sonics & Materials Inc., US) in the impinging device (AGI-30, SKC, US) and the active part of the probe was the planar circular surface, of area 1.3 cm^2, at the bottom of the probe.

Specimen preparation: The particles were separated from the dispersion after the addition of a large amount of acetone followed by centrifugation (for an effective separation of the silver particles) for 30 min. The precipitated particles, which were redispersed in ethanol, were used for the characterization studies. A drop of the dispersion was placed on a carbon-coated copper grid, which was allowed to dry before being used for observation *via* microscopy analyses.

Instrumentation: The size distributions of the aerosol gold particles was measured by a scanning mobility particle sizer (SMPS) system consisting of a nano differential mobility analyzer (TSI 3085, US), electrostatic classifier (TSI 3080, US), a condensation particle counter (TSI 3776, US), and aerosol charge neutralizer (4530, HCT, Korea). The SMPS system was operated with a scan time of 135 seconds

in a measurement range of 4.61-145.9 nm. After aerosol gold nanoparticles were sampled on a carbon coated copper grid located on a nano particle collector (NPC-10, HCT, Korea) 10 cm downstream of the spark generator, the morphology and microstructure of the gold particles were analyzed using a transmission electron microscope (TEM, 3010, JEOL, Japan) operated at 300 kV. X-ray diffraction (XRD) studies of the ZnO particle samples were carried out on a Rigaku RINT-2100 diffractometer equipped with a thin-film attachment using Cu-Kα radiation (40 kV, 40 mA). The 2θ angles ranged from 20 to 80° at 4° min^{-1} by step scanning at an interval of 0.08°. The optical properties of the dispersions were investigated by ultraviolet-visible (UV-vis) spectroscopy. Absorption spectra were recorded with a Perkin-Elmer 330 spectrophotometer (US), with a variable radiation wavenumber between 300 and 800 nm, at a rate of 60 nm min^{-1} and a spectral resolution of 2 nm.