SHORT ABSTRACT

Sechium edule, fruits of a perennial climber, is rich in ascorbic acid (AA 294 mg/kg dry fruit). In the first part of this work, the bio-analytes were extracted in an aqueous media for the synthesis of AgNPs. The study emphasizes on the mechanism of formation of mono-crystalline AgNPs at different pH which in turn controls the kinetics and size of AgNPs. Thermodynamically facile Ag_2O reduction at a higher pH (≥ 9) resulted in spherical particles of smaller sizes; however, the particles were laden with a trace of Ag_2O at pH 12.5. A broad and bimodal distribution of AgNPs of different shapes and sizes were originated at a lower pH ($3 \leq pH \leq 5$) from Ag^+ and Ag_2O reductions where AA mostly exists as dehydro-AA. AgNPs were tested for the inactivation of *Bacillus subtilis* and *Escherichia coli* bacteria. AgNPs were also found to be highly effective against pathogenic fungi *Aspergillus thermomutans*. The silver-ascorbate layer induced particles destabilization along with the formation of ascorbate free radical (g-factor: 2.0052 to 2.0056) which caused the synergistic affects for the microbial inhibition. Further, this work could successfully synthesize tailor-made Co and Pt NPs. The prismoidal, spherical, and core-shell structures of Co, Pt, and PtCo NPs were formed and, the mean particle diameter was found as of 47.3, 25.4, and 28.6 nm, respectively. A dense core of Pt or PtCo alloy was formed followed by a porous shell consisting of mostly Co with an average core-shell diameter of 13.2 nm–26.4 nm. The immobilized Ag^+ was completely doped onto TiO_2 (Ag/TiO_2) and ZnO (Ag/ZnO) in the presence of the bio-analytes. The proposed technique had dramatically shifted the optical absorption (~500 nm) to the visible domain and, the band gap of TiO_2 and ZnO were reduced to 2.5 and 2.8 eV. The crystallite size of TiO_2 and ZnO with the increase in Ag-loading was increased significantly. The saturation photo-electrochemical current density (46.68 mA/cm^2) at $E_{anode} \geq 0.31$ V vs. Ag/AgCl was almost double with Ag/ZnO than pristine ZnO under visible light illumination (λ_{mean}=525 nm, 18 K lux) and, the current density was insignificant in the dark. Ag/ZnO catalyst exhibited maximum 79.5 % degradation (71 % COD removal) of an anti-analgesic drug, dipyrone (100 µg L^{-1} dipyrone, catalyst 100 mg L^{-1}) resulted from the formation of $O_2^{\bullet-}$ radical (g-factor of 2.002 to 2.008), $^{\bullet}OH$ radical and paramagnetic oxygen vacancies (g-factor of 2.020) and, no effect of dye-sensitization was noted. The highest quantum yield was found to be 34.7%. The catalyst loss was 6% after the fourth cycle, and the dipyrone degradation was reduced to 70.8%. The synergetic effects of bimetals used for the doping of photocatalysts in the proposed route have a vast scope of researches in environmental pollution abatement, hydrogen generation, and CO_2 reduction.