Nanoplasmonics and surface enhanced spectroscopy

Plasmon induced synthesis of silver nanoparticles

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The prospect of using light to guide nanoparticle reactions is extremely attractive since one can regulate particle growth and generate a homogeneous population of product nanoparticles from a heterogeneous starting population. The best example of it is the plasmon induced synthesis of nanoparticles, which uses the visible light irradiation and plasmon excitation to drive the chemical reduction of Ag+ by citrate.

The synthesis of nanoparticles was conducted in two stages – after the reduction of Ag+ ions by sodium (I) borohydride at the presence of sodium citrate and polyvinylpyrolidon (PVP) the solution was illuminated inside of radial irradiators with 24 blue diodes during 96 hours. We have used different excitation wavelength – 450, 455, 458 and 458 nm respectively. Visual changes were observed less than 24 hours after the beginning of illumination. It means that particle shape had changed due to the photochemical decay of citrate ions and the reduction of Ag+ on a spherical seeds surface. It was determined that irradiation using blue light causes formation of decahedra shaped nanoparticles.

We compared our results to the numeric values of differences between plasmon resonance energy and excitation wavelength energy for prisms from the review [1]. The overall trend shows that the difference between plasmon resonance energy and excitation wavelength energy for product decahedral nanoparticles is lower than the same values for prisms. Moreover, it is clear that the ratio of Eex /Eres = 1.08 for decahedra, while for prisms Eex /Eres = 1.13 – 1.16.

1. *Langille M., Personick M., Mirkin C.* Plasmon-Mediated Syntheses of Metallic Nanostructures // Ang. Chem. - 2013. - 52. - P. 13910–13940.