Ultrasound-assisted green synthesis and deposition of metal nanoparticles in aqueous media

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In metal nanoparticle synthesis by sonochemical reduction method, metal nanoparticles are generally formed through the reduction of metal ions such as auric chloride ions ($[AuCl_4]^-$) by organic radicals (e.g., RCHOH▪) generated from sonolysis of alcohols and surfactants in aqueous solutions (reaction schemes 1 and 2)[1].

$$RCH_2OH + H▪\ (▪OH) \rightarrow RCHOH▪ + H_2\ (H_2O) \qquad (1)$$

$$3RCHOH▪ + [AuCl_4]^- \rightarrow 3RCHO + 3H^+ + Au^0 + 4Cl^- \qquad (2)$$

On the other hand, in our metal nanoparticle synthesis by sonochemical reduction method, gold nanoparticles are synthesized through the reduction of $[AuCl_4]^-$ by simply irradiation of high-frequency ultrasound to an aqueous $HAuCl_4$ solution in the absence of any alcohols and surfactants [2, 3]. We believe that $[AuCl_4]^-$ is reduced by hydrogen radicals (H▪) generated from sonolysis of water (reaction scheme 3).

$$[AuCl_4]^- + 3H▪ \rightarrow Au^0 + 4Cl^- + 3H^+ \qquad (3)$$

Furthermore, we found that gold nanoparticles were homogeneously deposited onto acrylic microspheres through the reduction of $[AuCl_4]^-$ in an aqueous acrylic microsphere dispersion by simply irradiation of high-frequency ultrasound in the absence of any additional reductants, stabilizers and binders such as alkylthiols and surfactants (Figure 1). The high-frequency ultrasound also allowed us to synthesize palladium nanoparticles and deposite the palladium nanoparticles onto acrylic microspheres in aqueous media.

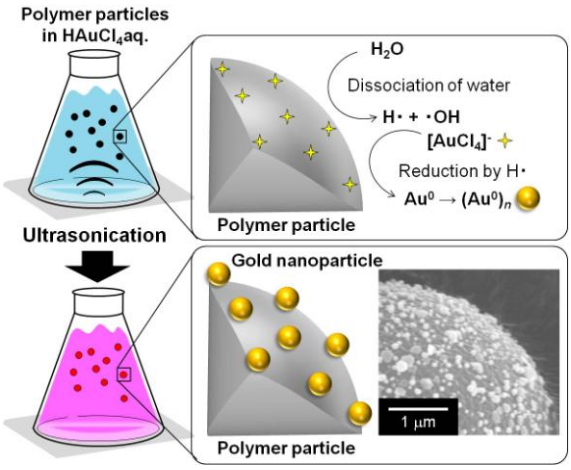

Figure 1. Schematic illustration on deposition of gold nanoparticles onto polymer particles in aqueous media by ultrasonication and scanning electron micrograph of gold nanoparticles-deposited acrylic microsphere.

Reference(s)

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