OPE3) Green Synthesis of Nanoparticles Using Extract of *Ecklonia cava* and Catalytic Activity of Synthetic Dyes

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1. 서론

Several attempts about the green synthesis of nanoparticles have been made due to its eco-friendly, nono-toxic, simple and low-cost nature. In this study, we synthesized silver and gold nanoparticles using an extract of the marine seaweed *Ecklonia cava* (EC). This extract of *Ecklonia cava* acted as both stabilizing and reducing agents for the growth of the nanoparticles. The formation of silver nanoparticles (AgNPs) and gold nanoparticles (AuNPs) was confirmed by the observation of UV-Vis absorption spectrum. Various properties of NPs were demonstrated using characterization techniques, such as DLS, transmission electron microscopy, EDX, X-ray diffraction, and Fourier Transform-Infrared Spectroscopy. The synthesized Ag and Au NPs were found to have important catalytic activity for the decomposition of organic dyes, including the azo dyes methylene blue, rhodamine B, and methyl orange.

2. 재료 및 방법

Chemicals and reagents

Ecklonia cava was obtained from JEJU TECHNOPARK Inc. (Jeju, Korea). Hydrogen tetrachloroaurate (III) trihydrate ($HAuCl_4 \cdot 3H_2O$), silver nitrate ($AgNO_3$), methylene blue, rhodamine B, methyl orange, and $NaBH_4$ were all purchased from Sigma-Aldrich Inc. (St. Louis, USA).

Green synthesis of AgNPs and AuNPs

1 mL of the filtered EC extract (2 mg/mL) was added to 1 μL of 1 M $AgNO_3$ solution and incubated in a water bath at 80°C. After 15 min, the suspension was moved to an icebox filled with ice for 5 min. Likewise, AuNPs were synthesized by this proceeses(1 M $HAuCl_4 \cdot 3H_2O$ solution).

Characterization of EC-AgNPs and EC-AuNPs

The synthesized EC-AgNPs and EC-AuNPs were characterized by UV-vis, DLS, HR-TEM, EDX, XRD and FT-IR analysis.

Catalytic activity of AgNPs and AuNPs

The catalytic activity of the synthesized AgNPs and AuNPs was analyzed based on the UV-Visible spectra of three dyes (MB, RB, and MO) in the presence of ice cold $NaBH_4$.

3. 결과 및 고찰

Ag and Au NPs were synthesized using EC extracts. UV-Vis spectroscopy and EDX analysis confirmed the formation of Ag and Au NPs. The size and morphology of EC-AgNPs and -AuNPs were determined using DLS and HR-TEM. Bragg's reflections from the (111), (200), (220) and (311) planes in XRD and SAED pattern confirmed that EC-AgNPs and EC-AuNPs were FCC in structure. FT-IR spectra suggested that EC extracts have an important role in synthesis and stabilization of NPs as a reducing and capping agent. The green-synthesized NPs were used as good nanocatalysts on the reduction of MB, RB and MO by $NaBH_4$. The order of the reaction was found to be pseudo-first order reaction. The rate constant of decomposition of dyes was determined by studying the reduction kinetics. In conclusion, algae-based synthesized NPs have excellent catalytic activity and reactivity as a cheap and environmentally safe catalysts for the degradation of various dye pollutants. Therefore, they may be highly useful for water purification and textile industries, and especially for environmental remediation.

4. 참고문헌

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