Enhancing Algal Bioremediation in Wastewater Using the Surface Plasmon Resonance of Silver Metal Nanoparticles as Optical Nanofilter

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Current wastewater treatments are complex, costly and leads to secondary pollution. Algal bioremediation is a viable alternative to removing heavy metals and toxic organic compounds from wastewater while producing valuable biomass and biofuels. However, excess light can result in radiation damage and toxic stress through the accumulation of reactive oxygen species. The localized surface plasmon resonance (LSPR) of silver metal nanoparticles have specific backscattering light filters that can be tuned to violet-blue regions of chlorophyll a (400-450 nm). Placing colloidal nanoparticles around culture flasks will increase the formation of photopigments by backscattering of light in the spectral regions favorable for growth. In this study, the potential of using silver metal nanoparticles as nanofilters to increase bioremediation was investigated. To do so, Chlorella vulgaris and Dunaliella salina were grown under secondary-treated wastewater in different nanoparticle solutions (0.001 M $NaBH_4$, 0.002 M $NaBH_4$) tuned to 400 nm. The growth of chlorophyll were measured through change in spectroscopy during a two-week period. Algal bioremediation were also measured using the Nitrate-Profi Test for nitrate and phosphate. Results showed C. vulgaris and D. salina experienced an enhanced microalgal pigmentation in the 0.002M $NaBH_4$ and 0.001M $NaBH_4$ nanoparticle solutions, respectively. The use of nanofilters increased algal bioremediation by four times- on average, algae grown in the nanoparticles removed 85% of organic compounds in comparison to 20% for trials grown without. It was concluded that this project significantly improves microalgal accumulation and bioremediation, making it a viable alternative to current tertiary wastewater treatments.