



**Investigation and Comparative Study of Zinc Oxide Nanoparticles Synthesized via
Green Chemistry and Sol-Gel Methods for Textile Coating and Photocatalytic
Degradation of Methylene Blue**

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Abstract

This project aims to study the green synthesis of zinc oxide nanoparticles and to evaluate their performance in cotton fabric coating and methylene blue degradation. Zinc oxide nanoparticles were synthesized using coriander leaf extract and the sol-gel method. The nanoparticles were applied to cotton fabric by dipcoating and spray-coating, and water contact angles were measured. The green-synthesized TEM image shows size of nanoparticles at about 100-150 nm, while sol-gel nanoparticles at 5-20 nm. Cotton coated with sol-gel nanoparticles showed a higher water contact angle at 79.23° compared to 74.00° from the green method, maintaining hydrophobicity after 15 washing cycles; spray-coating also performed better than dip-coating. In methylene blue degradation, sol-gel ZnO showed the highest efficiency at 56.5%, whereas the green method achieved 40.58%. These findings indicated that the sol-gel method provided better particle size control and dispersion, resulting in higher surface area and improved photocatalytic properties

Keywords: ZnO NPs, green synthesis, sol-gel, coated fabric, photocatalysis