

In vitro synthesis of nanoparticles and growth mechanism using recombinant *Escherichia coli*

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The remarkable physico-chemical properties of engineered nanoparticles have a fast increase in interest and achieved remarkable development. Most of nanoparticle synthesis processes were chemically synthesized with high temperature, pressure, and using expensive catalysts. Nowadays, many researchers are reported that biosynthesis of nanoparticles using microorganisms. The recombinant *Escherichia coli* strain was used in this study. All the *in vitro* synthesis of nanoparticles was observed the scanning transmission electron microscopy (STEM), energy-dispersive X-ray spectroscopy (EDS), and X-ray crystallography (XRD). The results of this research provide to *in vitro* synthesis of nanoparticles using recombinant *Escherichia coli* and understanding of nanoparticle growth mechanisms.