Biogenic production of selenium nanoparticles

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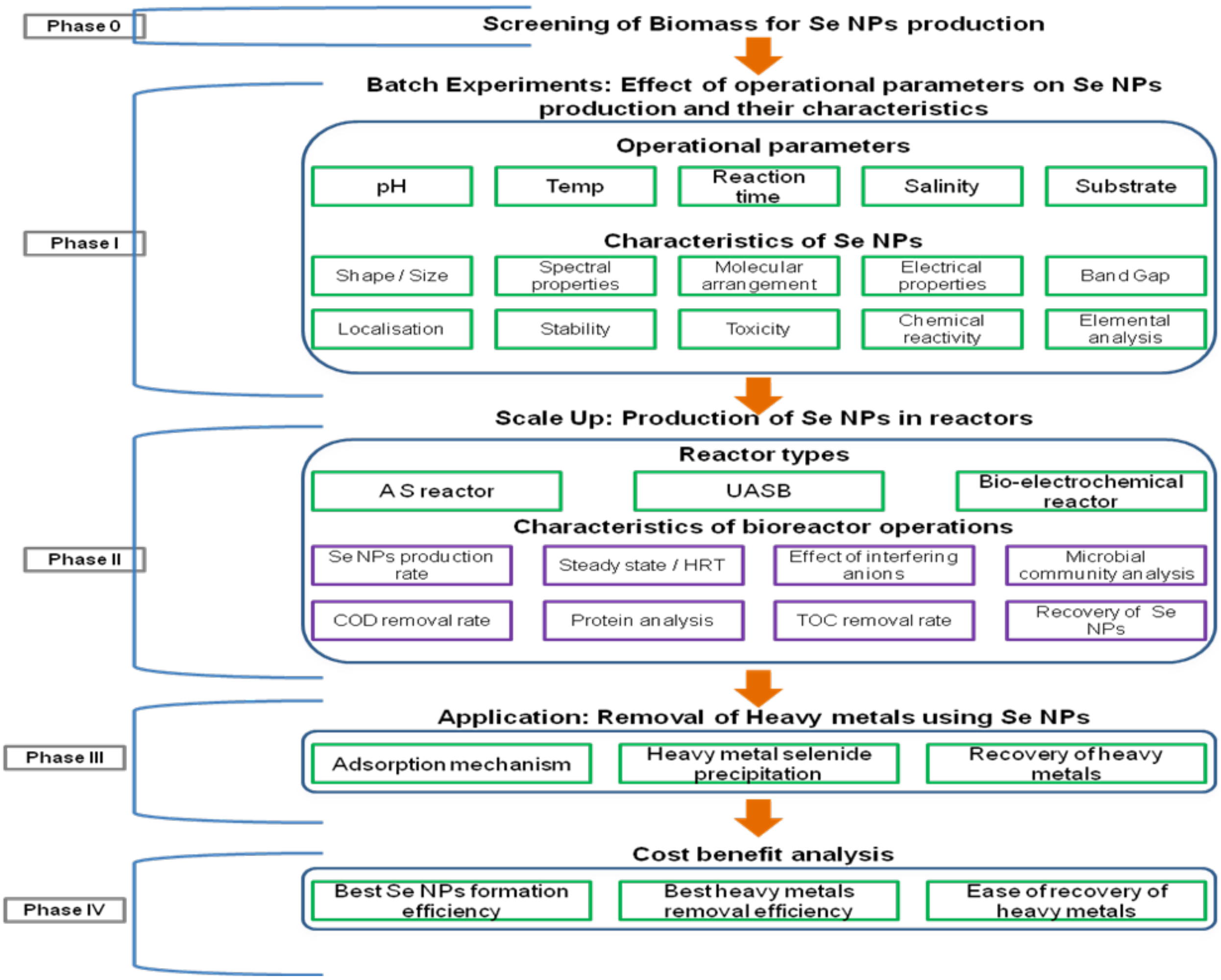
Abstract:

Nanotechnology is fundamentally changing the ways we address challenges in every field including manufacturing, energy, medical treatment, transport - to name a few. From environmental science's perspective, nanoparticles can help us build selective membranes that can remove contaminants and even salt, nanostructured traps that can remove pollutants from industrial effluents, improve industrial sustainability by significant reduction in material and energy use and increased opportunities for recycling. This exciting proposition in nanotechnology leads to an interest in the field of selenium nanoparticles. Research is being carried out to use selenium nanoparticles for medicinal use such as antifungal application, anti-cancer orthopaedic implants or treatment of malignant mesothelioma. Nanowires formed by selenium nanoparticles demonstrate novel photoconductivity. Amorphous selenium nanoparticles have showed unique photoelectric, semiconducting and x-ray-sensing properties. Cadmium selenide quantum dots can lead to optoelectronic devices with tailored properties. From environmental point of view, selenium nanoparticles have shown potential in the removal of mercury contamination. However, a reproducible but simple method of preparation of stable selenium nanoparticles with good catalytic properties is still a challenge. Biogenic production of selenium nanoparticles has shown a lot of promise over its chemical production route in terms of stability and more unique properties. Also, when the biological production of selenium nanoparticles is coupled with selenite and selenate removal from waste water, the process can become potentially very attractive in terms of cost and benefits. However, the biological process still lacks the understanding of controlling the size and shape and thus the properties of selenium nanoparticles produced.

This PhD research tries to decipher the effect of different operational parameters on the produced selenium nanoparticles' characteristics. It has been reported that the higher pH and temperature lead to formation of monodisperse and smaller sized silver nanoparticles, however, effect of temperature and pH has not been yet studied on characteristics of produced selenium nanoparticles. Moreover, salinity and electron donor also affect the characteristics of produced selenium nanoparticles. The next step would be to take up the production of selenium nanoparticles from shake flasks to Activated sludge, Upflow anaerobic sludge blanket reactor (UASB) and Microbial Electrochemical cell (MEC) configuration. As all of above three reactor system presents three different electron transport chains - Aerobic (oxygen being electron acceptor), Anaerobic (selenium oxyanions being electron acceptor), and Electrochemical (electrode being electron donor), it would be interesting to determine whether the different electron transport chain would affect the characteristics and primarily size and molecular arrangement of



selenium atoms in selenium nanoparticles. These reactor systems will also give us an insight on mechanism of the selenium oxyanion reduction and selenium nanoparticles formation. Finally, we would like to use the produced selenium nanoparticles for heavy metal removal from waste water. Heavy metal removal using selenium nanoparticles relies on adsorption of heavy metals on the surface of selenium nanoparticles and then removal by ultra filtration or formation of metal selenide and precipitation.

References:

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