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1-1-2020

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Recommended Citation

Jayawardena, Suurangi, "Development of Targeted Anti-Infective Nanotherpeutics for Photothermal Treatment Against Drug Resistant Clinical Strain of Pseudomonas" (2020). *RCEU Project Proposals*. 95.
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Development of Targeted Anti-Infective Nanotheraputics for Photothermal Treatment Against Drug Resistant Clinical Strain of *Pseudomonas*

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Proposal Identifier: RCEU20-CH-SJ-02

Project Description

Pseudomonas aeruginosa (PA), a gram-negative opportunistic pathogen is one of the leading cause of deaths in nosocomial respiratory tract infections.[1] An estimated 51,000 PA infections occur in the United States each year where more than 6,000 (13%) of these are multidrug-resistant (MDR) PA strains.[2] This project proposal is on the development of an anti-infective treatment against antibiotic (colistin) resistant clinical PA strain. The anti-infective treatment is based on a unique porous gold nanocarrier, which upon laser irradiation increases localized heat at the site of infection (photothermal treatment). The project involves the development of a liposome encapsulated antibiotic (colistin) loaded porous gold nanoparticle (NP). Liposome outer layer will be conjugated with a PA specific antibacterial peptide.

Student Duties, Contributions and Outcomes

Student Duties: ***a)*** Porous gold nanoparticle synthesis and characterization. (1-4 weeks); ***b).*** Antibiotic loading on porous gold, followed by characterization and quantification of antibiotic. (1-3 weeks); ***c).*** Antibiotic loaded porous gold NPs loaded in a liposome followed by characterization. (1-2); ***d)*** Quantification of the antibacterial efficacy of the encapsulated drug. (1-4 weeks).

Tangible Contributions - A successful project would be strongly considered for Material Research presentation done by the tri-campus research program held in January the following year. A positive outcome in the project (e.g. Successfully treatment of a PA infection by photothermal therapy), will lead to the student been awarded co-authorship in high-impact factor journal publication.

Specific Outcomes – skill based ***a)*** Synthesis and characterization of gold NPs – room temperature template method synthesis using surfactants and reducing agents; dynamic light scattering (DLS), UV-visible (UV-vis) spectroscopy, porosity

measurements ***b)*** quantification of drug loading – thermogravimetric analysis (TGA) ***c)*** liposome encapsulation and peptide conjugation – extrusion method, bioconjugation techniques. **Knowledge based** ***a)*** nanomaterial synthesis and characterization methods ***b)*** bioconjugation techniques

Student Selection Criteria – Students who have taken Organic I (CH331) or whom that major/minor in Chemistry or Chemical Engineering will be favorably considered. This project is open to students from any academic rank.

Faculty Mentorship – Student will be under the guidance and the overall supervisions of the PI. A graduate student (Ph.D. candidate) will be assigned as an immediate mentor (graduate mentor) and the student will always work along side with their graduate mentor. The graduate mentor will do the initial training gold NP preparation and characterization, where the mentee will first observe/shadow and learn the techniques (1-2 weeks), once the training is completed student will work while been observed by the mentor. The student will train under the supervision of the PI and graduate mentor to synthesis of few nanometer gold particles to several hundred nanometers of liposomes. The training in the synthesis of complex nanoassembly is invaluable for students going in for graduate programs or industry careers in areas of biotechnology, biomedical engineering, chemical engineering and materials chemistry. Individual meeting would be held once/twice a week where the student will present his/her progress or problems of the project. Group meetings will be held twice a week where they will present their work to the entire group.