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# Synthesis of Photcoupling Heterobifunctional Linkers for Nanomaterial Surface Functionalization

Surangi Jayawardena
*University of Alabama in Huntsville*

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Surangi Jayawardena, Assistant Professor, Department of Chemistry

MSB 305, 256-824-5445; E-mail: hj0022@uah.edu

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## Project Description

A major challenge in materials science is the ongoing search for coupling agents that are readily synthesized, capable of versatile chemistry, able to easily functionalize materials and surfaces, and efficient in covalently linking biological molecules and inorganic surfaces. Perfluorophenylazides (PFPA) as the coupling agents in surface functionalization and nanomaterial synthesis. PFPAs serve as heterobifunctional coupling agents by bringing together biological molecules and nanomaterials via the two reactive centers, that is, a chemoselective functional group and the light-activatable azido group. Biological molecule is then coupled to the nanomaterial surface by activating the surface azido groups

## Student Duties, Contributions and Outcomes

I. Synthesis of PFPA-COOH – Perfluorophenylazide carboxylic acid synthesis uses a conjunction of refluxation and solvent extraction. (1-2 weeks)

II. Synthesis of PFPA-NHS – Perfluorophenylazide N-hydroxy succinimide synthesis, gravity column purification along with NMR analysis. (2-3 weeks)

III. Synthesis of PFPA-silane– Perfluorophenylazide silane synthesis gravity column purification along with NMR analysis. (3-4 weeks)

IV. Synthesis of silica nanoparticles and surface functionalization of PFPA-silane – Silica nanoparticle synthesis and purification using Stober method. Surface would be functionalized with PFPA-silane. (5-10 weeks)

V. Characterization – Functionalized SNPs would be characterized using Fourier transform –infra red (FT-IR) spectroscopy and dynamic light scattering. (5-10 weeks)

*Manuscript/Poster Preparation* – Participating student would be strongly encouraged to write up their research project results in the format of Journal of American Chemical Society (JACS) or least have the results in form of a poster presentation for ACS regional meeting. A successful project would be strongly considered for publication with additional data where the student could be a co-author or combined first author along with a graduate student of the group.

**Faculty Requirement and Mentorship**

*Expected Student Background* – Students should have a background Organic Chemistry. Student major in Chemistry, and or Chemical Engineering would be benefited. *Expected results and deliverables* – Participating student would be exposed to state-of-art nanomaterial synthesis and characterization in a real world application. Students would be exposed to simple synthesis of small molecules and bio conjugation chemistry. Students would be encouraged to maintain standard laboratory notebooks and would be exposed to good laboratory practices. They would be expected do a scientific presentation each week and hence be exposed to a peer review setting where their work would be critically analyzed. *Faculty Supervision and Mentoring* – Dr. Jayawardena will supervise all the steps in nanoparticle preparation and application. Including final manuscript preparation. Group meeting would be held weekly where the student will present his/her progress or problems of the project with the entire group. The student will have access to the instructor at least once a day.

**Prior Awardees**

RCEU 2018 - Quantification of the Limit of Detection of Pathogenic Bacteria Using a Glyconanomaterial Based Rapid Point-of-Care Diagnostics System – James Johnson

RCEU 2018 - Functionalized Nanomaterial as a Tool for Rapid Point-of-Care Diagnostics – Melinda Mustain

RCEU 2018 - Synthesis of Multivalent Glyco-Magnetic Nanoparticles for Rapid Point-of-Care Diagnostics System – Veer Devarasetty

Student contribution: all students work surmounted to a provisional patent submitted by UAH, data for two SERMACS poster presentations, *manuscript in preparation* Rapid Point-of-Care Diagnostic of Mycobacteria using Multi-Core Shell Magnetic Silica Nanoparticles