Ehsan Shirzai Sani 1, Zhewen Zhang 2, Prasanthy Garlapati 3, Stephanie L Wunder 3, Bojeong Kim 4

1)Boeing/Engineering Department, Team University, Philadelphia, PA 19122, 2)Department of Chemistry, Vanderbilt University, Nashville, TN 37235, 3)Department of Chemistry, Temple University, Philadelphia, PA 19122, 4)Department of Earth and Environmental Science, Temple University, Philadelphia, PA 19122, kim@temple.edu

DEVELOPMENT OF IN-SITU REMEDIATION TECHNIQUE FOR POLYCYCLIC AROMATIC HYDROCARBONS IN SOILS: 1) STABILITY OF FLUORESCENCE-LABELLED SiO2 NANOPARTICLE-SUPPORTED LIPID BILAYER IN MICRO-MODELS

Abstract
Polyaromatic hydrocarbons (PAHs) are considered as priority pollutants by the EPA since they are widespread, serious risks for ecosystems and human health due to their carcinogenic and mutagenic effects. PAHs have low water solubility, and are strongly adsorbed onto environmental surfaces, accumulating in soils and sediments. Elevated levels of PAHs have been detected in urban (sub)soil/soil surfaces throughout the US, in concentrations often several orders of magnitude greater than established EPA screening levels. We here show that fluorescence-labelled monolayer supported lipid bilayers (NP-SLB) formed using incorporating, environmentally-friendly, fluorescent dyes, such as SiO2 nanoparticles, as well as a natural organic matter component, lipids can remove PAHs. Here, we aim to examine the stability and feasibility of the remediation method under various environmental conditions by testing migration in different environments. We found that SiO2 nanoparticles dispersed with lipid monolayers (MLVs) were stable in UV and chloroform exposure, followed by drying overnight under vacuum. The dry lipids were leached in salt or water solutions at 40 °C. From measured (1) to form monodisperse liposomes (MLVs) and chloroform (2) through fluorescent labels in an Avanti Polar Lipid extract at 40 °C to form small unilamellar vesicles (SUVs). The SUVs had an average diameter (D) of 100 nm, and a slightly broader distribution of ± 5. The UV-Vis absorption maxima of the SUVs was 191.5 nm and their emission maxima was 290 nm. These vesicle suspensions were used to form supported lipid bilayers (SLBs) on a nonionic 300 mm diameter silica nanoparticle (Nanosys Chemical: American Corp. Houston, TX, USA, in diluted solution) by incubation of the SUVs and SiO2 nanoparticles, for 1 h at 4 °C. The SUVs were then coated so that the nominal surface area (S) of the SiO2 and SUVs were the same, i.e. where SUV/SiO2 = 1, or where this amount of lipid was used. i.e. SUV/SiO2 = 1 to 2. In these experiments, there were approximately equal populations of SUVs and SLBs. However, the SUVs did not remain in the supported bilayer lipid layer of 5 mm, and NaCl 30 and NaCl 100 mM did not affect

Materials and Methods
- **Chlorine**, Fluorescein ethyl (GFP), Hoechst grade water, thio-terthiobarbituric acid (TTB) and (Tao-3) -unlabelled tetrabutylammonium (TET) (Thermo Fisher Scientific) were used for the synthesis. TEOG and Nile Red labels were generally dissolved in ethanol. All reagents were purchased from Sigma-Aldrich. The dispersed silica nanoparticles, bound on the top of a Fluorescent Cell 350 ESL Erythrocytes, were used as cells. Centrifugations were done on dry. Dynamic light scattering and 0-1 x 1 and 0-5 nM turbidimetric measurements were made on Malvern Nano Zetasizer, and TEM images were obtained using JEOL JSM-6335 scanning electron microscopes. UV-visible and fluorescence data were acquired with micro-channel 100 nM 100 nM and 12.5 nm for measurement. Formation of small unilamellar vesicles (SUVs) and supported lipid bilayers (SLBs), small unilamellar vesicles (SUVs) were 100 nm in diameter, in which 5% of the fluorescent lipid 4-6-AF (4+6-aminofluorescein) and 8-methyltritylcholesterol (MTC) (Invitrogen, 758.007 GDA (Bio-Rad) (Invitrogen, Thermo-Fisher-Scientific), SUVs) were used. The negatively charged lipid, which contained 10% of α-DPPE (non charged) (and 1) is sometimes used with SUVs. Two fluorescent label membranes (TCA, non-charged) were used simultaneously in flow 350 ESL Erythrocytes, and the same diluted solution was used in our case. The dispersed silica nanoparticles were stable in UV and chloroform exposure, followed by drying overnight under vacuum. The dry lipids were leached in NaCl solutions at 40 °C. From measured (1) to form monodisperse liposomes (MLVs) and chloroform (2) through fluorescent labels in an Avanti Polar Lipid extract at 40 °C to form small unilamellar vesicles (SUVs). The SUVs had an average diameter (D) of 100 nm, and a slightly broader distribution of ± 5. The UV-Vis absorption maxima of the SUVs was 191.5 nm and their emission maxima was 290 nm. These vesicle suspensions were used to form supported lipid bilayers (SLBs) on a nonionic 300 mm diameter silica nanoparticle (Nanosys Chemical: American Corp. Houston, TX, USA, in diluted solution) by incubation of the SUVs and SiO2 nanoparticles, for 1 h at 4 °C. The SUVs were then coated so that the nominal surface area (S) of the SiO2 and SUVs were the same, i.e. where SUV/SiO2 = 1, or where this amount of lipid was used. i.e. SUV/SiO2 = 1 to 2. In these experiments, there were approximately equal populations of SUVs and SLBs. However, the SUVs did not remain in the supported bilayer lipid layer of 5 mm, and NaCl 30 and NaCl 100 mM did not affect

Discussion
The adsorption of lipids on nanoparticles can control their anti-fouling properties and enhanced colloidal stability and mobility. Next, to establish the potential of PAHs in soil remediation, we fabricated and characterized single nanoparticle-suspended PAHs in oil and prepared nanoparticle PAHs with different features including their transport through water-based nanoreactor systems.

References