**NC-1194 Annual Meeting Minutes, May 24 – 25, 2019**

*Rutgers University Food Science Building, Room 120 (65 Dudley Rd., New Brunswick, New Jersey)*

Attendees:

Paul Takhistov, Rutgers Univ. (host)

Vangie Alocilja, Michigan State University

S. Gunasekaran, UW Madison

Anhong Zhou, Utah State University

Olga Tsyusko, University of Kentucky

David Monks, NC State (acting as project administrator for Steve Lommel)

Jeremy Tzeng, Clemson University (chair)

Mengshi Lin, Univ. of Missouri (vice-chair)

Daniel Jenkins, Univ. of Hawaii (secretary)

Meeting officially opened at 9:20 AM, May 24.

Welcome from Paul Takhistov, and turning of meeting over to current committee chair Jeremy Tzeng.

David Monks was welcomed as acting project administrator (on behalf of Steve Lommel). David shared some remarks about enhancing participation and membership in the group, that report on annual meeting will be due within 60 days of conclusion of this meeting, and that the current project will end in 2021 so that the group should start planning for a renewal proposal accordingly.

Self-introductions

*Paul Takhistov*, Professor Food Science Rutgers University, graduate faculty member of Chemical Engineering and other departments. Expertise on colloids / solid – liquid interface, delivery systems, new materials, emulsions, particles, edible films, etc.

*Vangie Alocilja*. Michigan State University, Nanotechnology based biosensors, case uses focus on global health i.e. TB and antibiotic resistance.

*Sundaram Gunasekaran*, Biological Systems Engineering, University of Wisconsin Madison. Overlapping focus with Vangie but broader with respect to applications, nanoparticle synthesis, energy applications (i.e. supercapacitors), encapsulation and delivery.

*Anhong Zhou*, Biological Engineering at Utah State. Biosensors., started in electrochemical sensors, now looking at bioimaging i.e. cancer cells, dividing bacterial cells with and without antibiotic cell wall inhibitors.

*Olga Tsyusko*. Plant and Soil Sciences, University of Kentucky. Focused on nanomaterial toxicity, background on metal nanomaterials, mechanisms of toxicity, multigenerational effects. Also interested in nanopesticides (i.e. copper based). Model organisms *C. elegans*, earthworms.

*David Monks*- (filling in for Steve Lommel as project administrator) Weed Science, North Carolina State University.

*Jeremy Tzeng*, Biological Sciences at Clemson University. Works on alternatives for antibiotics, i.e. nanoparticle based, and biosensors, implant materials with antimicrobial properties, medical implants with sensors for biological film; will be on sabbatical in Taiwan looking on alternatives to antibiotics to support animal growth.

*Mengshi Lin*, Food Science, University of Missouri, Food safety and quality, biosensors / nanosensors for safety and food quality i.e. pesticides, bacterial cells and biological contaminants. Surface enhanced Raman spectroscopy (SERS) based on nanomaterials with enhanced sensitivity allows ppb level detection of pesticides and single bacterial cells. Also works on toxicity of nanoparticles (i.e. silver and gold for intestinal gut microflora). Nanocellulose based biofilms / edible films, and as platform for SERS based nanosensors.

*Daniel Jenkins*, Molecular Biosciences and Bioengineering at University of Hawaii, focuses on sensors and instrumentation design, molecular probe technologies, and trying to work more on custom instrumentation for natural resource management (i.e. surveillance of wilderness for identification of invasive organisms).

**Station Reports**:

*Vangie Alocilja*. “Magnetically actuated pathogens for rapid screening of antimicrobial resistance” Focused on technologies appropriate for low-resource settings (so replacement for unsustainable antibody and other bioaffinity / molecular probes); non-specific adhesion to bacterial cells (not human cells i.e. blood cells), for multi-drug resistance / extensively drug resistance TB. Digital AI based approach, using staining of genomic DNA extracted from captured bacteria; replace traditional plating based method with captured aggregates for determining antibacterial resistance (i.e. bacterial growth can be observed by “smearing” of cells on tube wall when aggregated by magnet). Working on assembling a database of minimum inhibitory concentrations of antibiotics against different pathogens.

*Sundaram Gunasekaran*. Developing Biosensors for Safety and Quality (draft summary article). Localized surface plasmon resonance / gold nanoparticle based detection of bacteria- potential for 10 CFU / 100 ml for *E. coli* based on color changes in solution. **Electrospinning natural polymers and compounds**. Electrospinning natural polymers (mucilage polysaccharides) into nanofibers; electrostatic discharge of spray directed at a charged plate- for high viscosity materials instead of atomizing will make a fiber. Applications include drug delivery (wound healing dressing), binding heavy metals / water filtration, cell scaffolds. Natural polymers don’t electrospin well so most work is with blends with synthetic polymers. Also developing flow-through microfluidic cells for melanoma detection (DoD project).

*Anhong Zhou*. Configurable DNA electrochemical biochip and non-invasive extracellular vesicles detection for animal reproduction. DNA biosensor for cryptosporidium; Raman spectroscopy characterization of extracellular vesicles from bovin placenta and peripheral blood mononuclear cells- trying to elucidate communication between placental and maternal immune cells (through extracellular vesicles)- SEM, Raman / SERS / dynamic light scattering (DLS) for characterization, differentiation of vesicle types using PCA, PCA-LDA of characteristics- ultimate objective non-invasive assessment of Raman spectra for identifying stage of pregnancy. Smartphone based colorimetric assay (ongoing) on paper-based material- blood glucose with Android app.

*Olga Tsyusko*. Research on toxicity, genomic and epigenetic effects of nanomaterials at the University of Kentucky. Toxicity, avoidance and molecular mechanisms of Ag nanotoxicity in earthworms Eisenia fetida. Transcriptomic effects of Au nanomaterials in C. elegans, transformed Ag and ZnO in C elegans, response of legume Medicago truncatula to aged biosolids, genomic and epigenetic effects chronic exposure of C. elegans to Ag nanomaterials, toxicity of Cu(OH)2, toxidity of nano-phosphorene to C elegans. Fate and transport of manufactured nanoparticles (MNP)- in sewage sludge (60% is applied as biofertilizer). Environmental transformation Ag sulfidized, ZnO phospatization, sulfidation. Primary model organism is Caenorhabditis elegans (short generation time, abundant functional genomic tools for evaluating mechanistic effects / hypotheses); toxicity mediated by solubility / dissolution. Toxicity of transformed (sulficized silver) diminished by ~10-20x relative to pristine nanoparticles- similar observation for zinc nanoparticles (largely/ partially due to differences in solubility / dissolution)… major differences observed in gene expression profiles for different forms of nanoparticles, and transformed NPs. Increased multigenerational reproductive sensitivity in response to Ag ions and Ag-MNPs, but not transformed Ag-MNPs- up to about 10 generations. Germline mutations to exposure to NPs observed consistently numerically, but not statistically significant (?)- but no differences in mutation events depending on different NP type i.e. transformed vs. pristine. Epigenetic analysis (histone and DNA methylation to modify gene expression). High NP loading in biosolids applied to legume inhibited root nodulation; not so much at normal levels.

*David Monk*- relaying suggestions from Steve Lommel. Project expires 2021- we’ll need to renew project, **should work on a draft to be complete summer 2020** (sometimes groups can request 1 year extension; station directors will notify project of needs). Committees evaluate whether there are good reasons for continuation, participation. USDA-NIFA has narrowed down new site for location to three sites (Indiana, Kansas City Missouri, NC research triangle)- decision will be made soon, two or three sites being evaluated at each location. House and Senate passed spending package in February- NIFA has $64M increase. $54M increase for APL priorities (Hatch, Smith Lever, Evans Allen, extension, Mcintire-Stennis). Federal funding requires state match; pressure for state legislatures to increase match… There is a new 1890 land-grant University. Mechanism to increase participation is to include graduate students in meetings (also improves professional development and exposure to opportunities), and they can represent future regular participants. Alocilja suggests that group identifies a single problem to focus on; formulation of renewed project should have more coherent focus on type of problem- and also to inspire passion among all members.

*Jeremy Tzeng*: Superparamagnetic iron oxide nanoparticle mediated inactivation of *E. coli* K99 (killing actuated by alternating magnetic field). Neisseria gonorrhoeae (2nd most common notifiable disease in US); particles targeted by polysaccharide modification of particle surface. Iron oxide particle interacts / binds to fimbriae on bacteria. Treatment of bacteria with nanoparticles also promotes aggregation of bacteria. Setting up instruments to use of mouse / animal models to treat bacterial infection.

*Mengshi Lin*: Applications of SERS and nanomaterials for detection of food contaminants. Two hypotheses for enhancement mechanism: Localized SPR / electromagnetic enhancement in nanometallic surface, or; chemical enhancement. Synthesis of gold nanostars (two-step controlled condition seeding) as substrate for pesticide detection in juice, detection limits into the ppb level. Cellulose nanofibers coated with silver nanoparticles as SERS substrate (detection of pesticides in apples)- flexible as a surface wipe / swab. Investigation of toxicity (antimicrobial activity) of CNF-Ag nanoparticle on *E. coli*; no strong toxicity on animal cells.

*Daniel Jenkins*: “Portable diagnostic technologies: ABE-Stat and RNAseH probe”. Described new molecular probe design for differentiating SNPs using isothermal amplification compatible with existing portable instrument(s)- solicited input on model systems for validating in microbial testing (i.e. antibiotic resistance). Reviewed published details / capabilities of wireless handheld potentiostat “ABE-Stat”, and details of a revised design to improve noise performance and consistency of Electrochemical Impedance Measurements across frequency spectrum (0.1 Hz to 100 kHz).

*Paul Takhistov*: Detect, kill and eliminate bacteria using no chemical contamination, all-natural materials. Edible coatings and packaging to prevent bacterial growth and enhance nutritional value. In diluted state polymers coil as particles, at higher concentration with nanomaterials can aggregate. Fast dissolving nano-composite oral film (for oral drug delivery to children). Curcumin NP with enhanced antioxidant and antibacterial properties (i.e. inhibition / inactivation of *Listeria* growth). NP assisted photodynamic inactivation of bacteria (binding of curcumin NP to cells, exposure to UV light); encapsulation of antimicrobial agent (i.e. essential oils, to reduce required concentration to diminish costs and incompatible flavors i.e. to meat products). Characterization of different essential oils for inhibition of growth rate and lag time, to identify lowest cost oil system (i.e. to enhance food preservation / spoilage / postharvest loss). Rheology of nano-emulsion design to understand behavior in intestine (small particles governed by diffusion only so will not be transported / uptaken, large particles affected by bulk mixing / convection). 3D printing of functional food materials (for personalized nutrition- specialized nutritional profile / supplements).

After lunch, attendees took a field trip to visit the Rutgers University Makerspace that is an open-access, make-anything workshop.

**Saturday meeting (Discussion of Future Plans / Project Directions / Collaborations)**

Started at about 9 AM

Olga Tsyusko was nominated and seconded as NC-1194 secretary for 2020, vote was unanimously in favor. From the end of the 2019 meeting through the end of 2020 meeting NC-1194 has the following officers:

Chair: Mengshi Lin

Vice-Chair: Daniel Jenkins

Secretary: Olga Tsyusko

Annual group report will be due within 60 days of the end of reporting period (September 30, 2019). Mengshi Lin will take the lead on coordinating annual report, with assistance of Daniel Jenkins.

Location for 2020 meeting. Group proposed options to have meeting jointly with 2020 GRC conference on nanotechnology in food and agriculture; jointly with ECS PRiME in Honolulu October 4 – 7, Nanotech conference in Canada (not Washington DC). The 2nd world nanotechnology conference April 2020 Philadelphia. IAFP in Cleveland May. Could also find international conference. Or deviate from generic schedule and have meeting at individual station exclusive of conference. Some interest was expressed in having meeting at Hawaii.

Guna suggested that we send options to entire membership by e-mail within the next few weeks, and allow them to vote. Summary of proposed options include:

1. GRC / other national conferences (i.e. IFT, nanotech, IAFP, nanotechnology conferences); drawbacks for GRC is that time commitment is long, meeting format not conducive to a group meeting with sufficient depth to discuss and coordinate activities at different stations; partial registration is not allowed.
2. International meetings coordinated with local institution or conference important to US food supply / security / safety- specifically recommending Peru or Costa Rica, sites supplying fresh food / produce to US- May 20, 2020 (fly Thursday, return Sunday)
3. Group meeting in Hawaii hosted by NC-1194 Vice-Chair (prior to memorial day weekend)- could use opportunity to focus more on coordinating / finalizing renewal report.

Anhong suggested that option B maybe not be a good idea during the last year of project- should focus on US location to strengthen sharing of project outcomes, and to focus on finalizing proposal for renewal of project.

Guna suggests send options give people 2 weeks to reply, follow up with those not replying and ask for response in 2 days. Paul suggests that votes should also be contingent on commitment to participate.

**Discussion of Future direction / collaboration / focus for NC-1194**

1. During the previous day passion was expressed for addressing antimicrobial resistance. How can each of us contribute to helping address related issues.
   1. Guna suggested that Vangie identify specific topic areas related to problem, and identify individual(s) with expertise to help address.
   2. i.e. detection, mechanism, gene transfer, overuse of antibiotics / alternatives, wastewater and/or improper disposal.
   3. Vangie suggests that this is a highly topical area and opportune time for support from variety of agencies.
   4. Antibiotic resistance will lead to diminished livestock production (impact to farm economy and protein supply / food security for population).
2. Food safety- comprehensive approach to agile flexible response across the supply chain.
3. Recommendation to identify funding opportunity to focus on (differentiation / identification of antibiotic resistant strains harmonizes with focus of project).
4. One of NSF “10 big ideas” is convergence- multidisciplinary group moving to transdisciplinary research. Need to identify how different expertise in group can be complementary to a common purpose.
5. Guna suggests that those working on anything possibly related to antibiotic resistance, send short summary to Vangie, and she will try to coordinate a framework for collaboration. Also solicit ideas for other problems for project members to focus on. Should also encourage different station members to coauthor publications (i.e. Vangie suggests that gene probe in Jenkins group be used to cross validate for Klebsiella mutation conferring antibiotic resistance).
6. Jeremy suggests maybe project should have a quarterly conference call to report on progress and coordinate activities (each group contribute one slide).
7. Vangie will be conducting workshop with hospitals in August (13 and 14)- will request if they can support participation of other project members.

**Action items**:

1. Minutes will be posted within 2 weeks (after circulating for revision by attendees)
2. Annual report should be complete within 60 days of the end of reporting period (September 30, 2019).
3. Steering committee has proposed antibiotic resistance as a focus topic to work on- solicit input from members on expertise / technologies / facilities they can use to contribute to solving an aspect of the problem
4. Planning of annual meeting. Request feedback / votes for annual meeting 2020 after the labor day.
5. Need to start planning for renewal proposal for project (will be a major agenda item for 2020 but helpful to have draft earlier).
6. Need to encourage joint publications- even if just a review paper- with 2 or more stations.

Move to adjourn meeting at 11:25 AM (Guna), Mengshi seconded, approved unanimously (with thanks to Paul for hosting).