Nanotechnology Preeminent Team Faculty Seminar

February 22, 2017 @ 9:30am
BRK, ROOM 1001

Dr. Mohit Verma

Postdoctoral Fellow, Harvard University

Title: How to Engineer Human Microbiomes?

Bio: Dr. Mohit Verma is a postdoctoral fellow in Professor George Whitesides' laboratory at Harvard University. Dr. Verma received his PhD in Chemical Engineering (Nanotechnology) in 2015 and his BASc in Nanotechnology Engineering in 2012 from the University of Waterloo (Canada). During his PhD, he conducted research on the use of gold nanoparticles for detecting bacteria and on the use of polymeric nanoparticles for delivering drugs, under the supervision of Professor Frank Gu. He received the Vanier Canada Graduate Scholarship from the Government of Canada and the Endeavour Research Fellowship from the Government of Australia (for spending four months at the University of New South Wales) during his PhD. He currently holds the Banting Postdoctoral Fellowship from the Government of Canada. His research interests include human microbiomes, biosensors, drug delivery, and soft robots.

Abstract: We are surrounded by microbes with intriguing functions—they are in the oceans (where they produce 50% of the oxygen we breathe), in the skies (where they can act as seeds for cloud formation and influence climate globally), in the soil (where they can be as diverse as 40,000 species per gram and determine which crops survive), and in our guts (where they not only help with digestion but also influence inflammation, appetite, circadian rhythm, and behaviors)—but the tools to study complex microbial communities (microbiomes) are limited. A growing body of evidence suggests a correlation between changes in a microbiome and onset of diseases in humans, but in most cases, causality is not yet established.

We are developing tools based on nanotechnology, bioengineering, and analytical chemistry to understand causal relationships between microbiomes and their hosts, and to manipulate microbiomes for desirable outcomes, e.g. to shift patients from unhealthy to healthy states. One of these tools uses cationic gold nanoparticles to probe bacterial surfaces. We demonstrate that these nanoparticles can interact electrostatically with the cell walls of bacteria, and aggregate around them to produce a colorimetric response. These gold nanoparticles can potentially be used to separate bacteria within a microbiome and thus, to facilitate their characterization by genomics, proteomics, and metabolomics. These separation methods, coupled with other tools such as 3D *in vitro* cell-based models, will help us in understanding host-microbiome interactions and act as stepping stones for engineering human microbiomes.

.