Fluids at Brown, Division of Applied Mathematics
Fluids and Thermal Sciences, School of Engineering
Joint Seminar Series

TUESDAY – April 4, 2017
3:00 PM
Barus & Holley, Room 190

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Finding Bacteria: The Bad, The Good, and The Better

There are over 10,000 species of bacteria have been identified thus far and it is estimated that there are still millions more yet to be discovered. Of the known species, around 20% are known to be 'bad' for humans; that is, they can be infectious or harmful to the environment. For example, certain spices of *Escherichia coli* and *Salmonella* are well known for their ability to infect our digestive system. On the other hand, there are many bacteria that are 'good' for humans. Take for example, *Lactobacillus* bacteria which are used to ferment dairy products (e.g. cheese and yogurt), Pseudomonas that are used in bioremediation, and Bifidobacterium that live in our guts and protect against inflammation and infection. Still, while they have been exploited for their beneficial natural functions, better uses for bacteria can be found. One example of finding better uses of bacteria is the use of their organelles, specifically their flagella, for engineering applications. Bacterial flagella are helical nantotubes that bacteria rotate in order to move. These naturally occurring nanostructures have many unique properties that can be manipulated for numerous applications. Since the 1960s it's been known that self-assembly of flagella can be manipulated in vitro, such that flagella can be 'grown' to lengths 10 times their normal length. Utilizing this knowledge, flagella have been used as biotemplates for inorganic nanotubes, including silver, titanium, and silica. Using flagella as nanotemplates versus fabrication of purely inorganic nanotubes has a number of advantages including lower cost, faster fabrication times, and are more environmentally friendly. Once fabricated, these biotemplated structures could be used in electrodes, dye sensitized solar cells, or as hydrophobic/hydrophilic coatings. In addition to biotemplates, bacterial flagella by themselves can be used for the propulsion of abiotic swimming microrobots. Mimicking how real bacteria swim, using a low power rotating magnetic field to rotate flagellated magnetic microparticles, a possible tool for *in vivo* applications, such as targeted drug delivery and minimally invasive surgery could be achieved. Another application of flagella can be derived from their hollow structure; bacterial flagella have a pore that is approximately two nanometers in diameter. The porous nanostructure of flagella has the potential to be utilized in a novel filtration device. Specifically, if templated flagella were imbedded in a solid polymer resin and then sectioned, a nanoporous membrane could easily be fabricated. Furthermore, by functionalizing the pores, filtration of individual analytes could be realized. This filter could be used for the high-throughput separation of serum cytokines, or other low abundance chemicals, that act as biological biomarkers.

Short Biography

Dr. MinJun Kim is presently the Robert C. Womack Endowed Chair Professor of Engineering at the Department of Mechanical Engineering, Southern Methodist University. He received his B.S. and M.S. degrees in Mechanical Engineering from Yonsei University in Korea and Texas A&M University, respectively. Dr. Kim completed his Ph.D. degree in Engineering at Brown University, where he held the prestigious Simon Ostrach Fellowship. Following his graduate studies, Dr. Kim was a postdoctoral research fellow at the Rowland Institute in Harvard University. He joined Drexel University in 2006 as Assistant Professor and was later promoted to Professor of Mechanical Engineering and Mechanics. Dr. Kim has been exploring biological transport phenomena including cellular/molecular mechanics and engineering in novel nano/microscale architectures to produce new types of nanobiotechology, such as nanopore technology and nano/micro robotics. His notable awards include the National Science Foundation CAREER Award (2008), Drexel Career Development Award (2008), Human Frontier Science Program Young Investigator Award (2009), Army Research Office Young Investigator Award (2010), Alexander von Humboldt Fellowship (2011), KOFST Brain Pool Fellowship (2013 & 2015), Bionic Engineering Outstanding Contribution Award (2013), Louis & Bessie Stein Fellowship (2008 & 2014), ISBE Fellow (2014), ASME Fellow (2014), Top 10 Netexplo Award (2016), and KSEA & KOFST Engineer of the Year Award (2016).