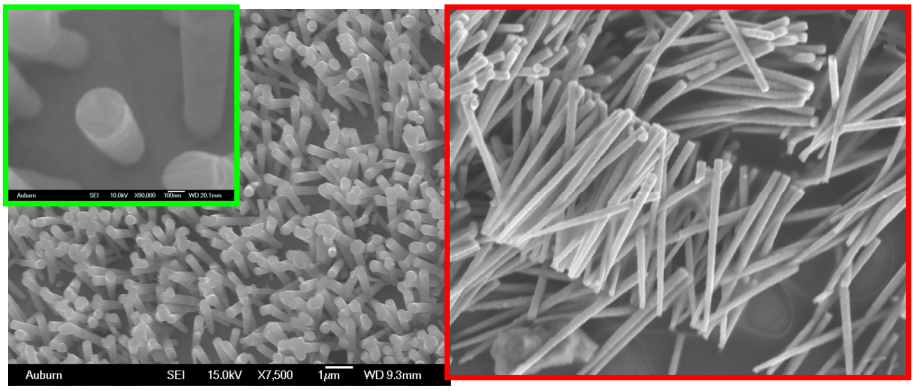
Nanoscale magnetostrictive particles as biosensor platforms for in-situ detection

Biosensors are considered as next-generation biological/chemical detection technology since the biosensors are easy to use and with a rapid response. Micro/nano-biosensors exhibit an unprecedented sensitivity and attract a great deal of attention in the development of high performance biosensors. However, these sensors face a great challenge – in order for the sensor to react with the target species, the sensor has to be brought to target species or the target species have to be brought to the sensor, which is more critical for the sample with a low concentration like foods and water. Therefore, a pretreatment process, such as concentration and enrichment, is generally needed. Magnetostrictive materials are the materials whose shape changes with external magnetic field. Therefore, magnetostrictive materials have been widely used for wireless sensors and actuators.

Taking the advantages offered by the magnetostrictive materials, nanoscale magnetostrictive particles (NMPs) in the bar and strip shapes are introduced as a high performance sensor platform. The NMPs provide following advantages: 1) a unique way to bring the sensors to the target species; 2) working well in liquid without pre-treatment of the sample; 3) being free-standing and interrogated wirelessly makes NMP sensors be deployed in different locations for in-situ detection; 4) detection of multiple targets simultaneously by using NMP sensors with different sizes and/or compositions. Sensors for the detection of different bacteria (i.e. *Salmonella, E. coli, and Listeria*) in water and liquid food have been developed by Dr. Zhongyang Cheng and his team at Auburn University using the magnetostrictive particles. A process to fabricate the NMPs in controlled shape and size as well as the composition has been established. The SEM picture below shows the NMPs.



SEM picture of bar-shape NMPs. The ends of these NMPs are flat and perpendicular to the length direction, which is critical for the NMPs to achieve high performance.

These accomplishments opens the door to a new type of nano-sensor that may be used in the field to monitor for the bacterial contamination (for instance *Salmonella*) of fresh food crops such as spinach, lettuce and tomatoes. These sensors would reduce the number of food borne illnesses experienced in the United State. These sensors can be used in clinic for the diagnosis, which would make the diagnosis more inexpensive and available to all clinics for rapid diagnosis.

Z.-Y. Cheng, S.Q. Li, K.W. Zhang, L.L. Fu, and B.A. Chin. (2009). Novel Magnetostrictive Microcantilever and Magnetostrictive Nanobars for High Performance Biological Detection, Smart Materials & Micro/nanosystems, Vol. 54, 19-28 (2009).

A U.S. patent was granted for the biosensors using magnetostrictive particles.

Auburn University is working with 3M on the commercialization of the sensors for clinic diagnosis and negotiating with a few companies for the commercialization of the sensor for food safety applications.

Contributing Agencies: USDA/CSREES, PNNL of DOE, USGS