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News

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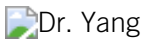
Dr. EH Yang's Research Team Awarded with NSF Grant on Pioneering Microfluidics Innovation

Funded by the National Science Foundation (http://www.nsf.gov/), Dr. Eui-Hyeok Yang (http://research.stevens.edu/Eui-Hyeok-Yang/rid/120) (PI) and Dr. Chang-Hwan Choi (http://research.stevens.edu/Chang-Hwan-Choi/rid/310) (co-PI) of the Department of Mechanical Engineering (http://www.stevens.edu/ses/me/) at **Stevens Institute of Technology** are investigating precise manipulation of liquid droplets on a smart polymer at ultra-low voltage (less than one volt), representing a major advance in the future of digital microfluidics research. The low voltage requirements of their innovation could facilitate the development of portable, handheld medical testing devices directly powered by AAA batteries. That portability is critical for microfluidic systems to realize their full potential in rapid diagnosis applications.

"Microfluidics is already a billion-dollar industry," says Dr. Michael Bruno (http://research.stevens.edu/Michael-Bruno/rid/54), Dean of the Charles V. Schaefer, Jr. School of Engineering and Science (http://www.stevens.edu/ses/). "The realization of this technology opens up new market opportunities and establishes a new horizon for scientific research based on disruptive portability."



Dr. Eui-Hyeok Yang

Dr. Yang and Dr. Choi envision a future in which, rather than visiting the doctor to undergo a screening, a patient could feasibly purchase a testing kit at a pharmacy and conduct the screening at home. The implications for healthcare thus amount to a paradigm shift, easing the stress and fear associated with medical testing and perhaps encouraging more people to participate in critical screenings.

Such a device would work upon the principles of digital microfluidics, which entails the manipulation of liquid droplets on a smart polymer surface by applying voltage, respectively making the surface hydrophilic (attracting water) or hydrophobic (repelling water).

This capacity to control the liquid makes it possible to automate a medical testing procedure in a portable device. As voltage is applied to regions of the circuit, a liquid droplet—a blood sample for instance—moves along a path to react with a fixed chemical reagent. The device then compares that reaction with the expected outcome for a positive/negative sample and determines if the blood sample indicates a certain disease or condition. Medical testing that usually needs to be done on a laboratory desktop can thus be conducted mechanically at home. However, current digital microfluidics apparatus generally

requires 20-40 volts to maneuver liquid droplets. Those voltage requirements mean that a biomedical device is more expensive and would likely only available at a doctor's office. Such high voltage is also not desirable in operating and testing many biofluids.

Dr. Choi

Dr. Chang-Hwan Choi

Dr. Yang and Dr. Choi's research innovates by using tunable wetting on special surfaces called "smart" polymers, which can be made to change their attraction to water at a very low voltage, making manipulation of droplets possible at as low as one volt.

The team is investigating the fundamentals that affect the functionality of a potential device. There are still many technical challenges to overcome, but meeting them will revolutionize digital microfluidics and create a new market for over-the-counter medical tests.

This groundbreaking research will also serve as the basis for educational initiatives with a special emphasis on recruiting students from under-represented minorities and exposing them to cutting-edge technology in an environment of scientific collaboration and teamwork. Student contributions have already proven significant to the progress of the research.

Dr. Yang and Dr. Choi's backgrounds have proven highly complementary through the course of their work. "In addition to illustrating the depth of their individual expertise, this research is a great example of the power of the collaborative environment at Stevens," says Dr. Costas Chassapis (http://research.stevens.edu/Constantin-Chassapis/rid/76), Deputy Dean of the School of Engineering and Science, and Director of the Department of Mechanical Engineering (http://research.stevens.edu/index.php/www.stevens.edu/me).

"Research today is highly interdisciplinary," says Dr. Yang. "You have to be creative and capable of building new research areas in the fertile space between disciplines."

Dr. Yang is currently PI on a number of active grants, in the area of research, education and equipment, from AFOSR (http://www.wpafb.af.mil/afrl/afosr/) and NSF (http://www.nsf.gov/). He directs the Micro Device Laboratory (http://www.stevens.edu/mdl/about.html) (MDL), a Stevens multi-user facility. He is also an Associate Editor of several journals including *IEEE Sensors*.

Dr. Choi is currently PI/Co-PI on grants from Office of Naval Research (http://www.onr.navy.mil/) (ONR), **NSF**, and American Chemical Society (http://portal.acs.org/portal/acs/corg/content). He has received the Young Investigator Award from the ONR. He is currently a director of Nano and Microfluidics Laboratory at Stevens (http://www.stevens.edu/nmfl/).

Learn more about the Mechanical Engineering (http://www.stevens.edu/ses/me/) department, or apply at Undergraduate Admissions (http://www.stevens.edu/sit/admissions/) or Graduate Admissions (http://www.stevens.edu/sit/graduate/).

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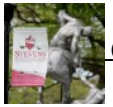
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