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NANOPARTICLES FOR DETECTION OF SINGLE TUMOR CELLS IN CIRCULATION

Solid tumors become deadly when they spread by releasing individual cells into the blood through a process called metastasis. Capturing metastasis before it is too late for treatment is critical to improve patient survival. Sensitive detection of those individual tumor cells in the circulation can detect metastasis early, and also monitor cancer progression and treatment response.

A novel method for detecting single tumor cells in blood is available for exclusive licensing from the University of Memphis. This new method is a significant improvement from current diagnostic tools. The current diagnostic tools are not sensitive enough to find individual tumor cells without significant sample processing.

APPLICATIONS

» Detection of single metastatic cells in unprocessed patient blood samples using commercially-available laboratory equipment.

ADVANTAGES

A simpler, faster, less expensive and more sensitive method for early detection of metastatic processes in oncology patients

» Simpler: Does not require sample fractionation or other processing of patient blood samples

» Faster: Allows sample analysis after simply mixing the detection reagent with the blood sample

» Less Expensive: Less staff time, a single reagent kit

» More sensitive: Capture tumor cells of multiple subpopulations.

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THE TECHNOLOGY

The technology is based on specific antibody-directed binding of novel iron oxide-gold core-shell nanoparticles to tumor cells directly in whole blood. The particles are made into a shape that is 30-50 times more sensitive to detection by Surface Enhanced Raman Scattering (SERS) spectroscopy compared to traditional spherical nanoparticles. The iron oxide core of the nanoparticles allows them to be concentrated and separated from blood matrix with a magnet. The specificity of particle binding to cells can be tightly controlled by the selection of a wide variety of monoclonal antibodies to cell surface markers of tumor cells. The detection is based on the subsequently on-chip signal readout of the Raman reporters that are coated on the surface of the nanoparticles via a Raman microscope. The SERS signals are highly sensitive (down to single particle level) and highly specific (fingerprint pattern distinct from biological background). Due to the combination of cell separation and detection with a single agent, in conjunction with a microfluidics device and the powerful Raman detection method, the new technology is simple, fast and less expensive, detecting single tumor cells in bloodstream for clinical cancer diagnostics and monitoring.

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THE INVENTORS

Dr. Xiaohua Huang is an Associate Professor in the Department of Chemistry at The University of Memphis. She received her PhD in Chemistry from Georgia Institute of Technology in 2006. She performed post-doctoral research at Georgia Institute of Technology and Emory University before joining The University of Memphis in 2010. Her current research focuses on development of new technologies for biomarker detection in biofluids for cancer liquid biopsy using nanotechnology, optical spectroscopy, and miniaturized devices.

Dr. Xiaohua Huang

Dr. Huang has published over 50 refereed articles in high impact journals such as Journal of the American Chemical Society, Chemical Society Review, and Nanomedicine. Her publications have been cited more than 30,000 times. She has been the principle investigator for several research grants from different agencies including National Institutes of Health/ National Cancer Institute. She has received several honors and awards including 2007 American Association for Cancer Research – Women in Cancer Research Brigid G. Leventhal Scholar, 2011 Oak Ridge Associated Universities' Ralph E Powe Junior Faculty Enhancement Award and 2012 Early Career and Research Award from the College of Arts and Sciences at The University of Memphis. She is currently a member of Editorial Board for Nanotheranostics.

Dr. Saheel Bhana was a Ph.D. student in the Department of Chemistry (2010-2015) at The University of Memphis. He graduated with a PhD degree in 2015 and is currently an Application Scientist at National Water Quality Laboratory, US Geological Survey. He received his bachelor degree in chemistry from the University of Tennessee in Knoxville in 2010. His research interests in Dr. Huang's group focused on the synthesis of novel nanomaterials for cancer diagnosis and treatment. He was awarded a travel fellowship by the New York Academy of Sciences to give a presentation at the Nanotechnologies in Cancer Diagnosis, Therapy, and Prevention Conference. He has published/co-published ten research articles in top peer journals.

Dr. Saheel Bhana

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