Dr. Samuel Achilefu, Washington University School of Medicine

Cancer Vision Goggles for Guiding Surgery

Abstract: Surgeons still rely on vision and touch to distinguish cancerous from healthy tissue, often leading to incomplete tumor removal that necessitates repeat surgery or favors relapse. To address these issues, we have developed Cancer Vision Goggles (CVGs) that can provide real-time intraoperative visualization of tumors and sentinel lymph nodes without disrupting the surgical workflow. The CVGs were designed to detect near-infrared fluorescence (NIRF) from molecular probes targeted to cancer cells. Both NIRF and normal visible light used in the operating room are projected to a head-mounted display. The optical see-through CVGs prototype allows direct visual access to the surgical field while projecting NIRF to the eyes under normal operating room light conditions. Aided by a tumor-targeted NIR fluorescent molecular probe, CVGs provided real-time image guidance for complete tumor resection in subcutaneous and metastatic mouse models of cancer with high accuracy. Using indocyanine green contrast, CVGs accurately predicted tumor margin status in breast cancer patients. CVGs may enable broad clinical adoption of fluorescence-guided surgery and improve outcomes in oncologic surgery.

Bio: Dr. Achilefu pioneered the development of molecular optical imaging and therapy of human diseases using novel near-near infrared fluorescent molecular probes and light-sensitive drugs. Dr. Achilefu has published more than 250 scientific papers and he is the inventor of 56 issued US patents. He first demonstrated the use of peptide-based cancer-targeted molecular probes and discovered a new molecule that synergistically interacts with biomolecules to report if tumors are benign or malignant. This led to the discovery of a new molecular entity that can be used to detect and deliver drugs to nearly all types of cancer. Dr. Achilefu also conceived and led the development of a novel wearable goggle-based imaging system for guiding surgical removal of tumors by instantly displaying fluorescent light from cancer cells in the wearable eyepiece. The system ensures that all cancer cells are removed. This recent invention has received worldwide acclaim. Recently, he co-discovered a novel treatment paradigm for cancer using a special type of light source and nanomaterials that can find and selectively trigger cancer cell death without harming healthy tissue. He has received several honors and award, including the 2014 St. Louis Award, 2014 Medical Innovation Award by the St. Louis Business Journal, 2015 Outstanding Scientists Award by the St. Louis Academy of Science, and Blacks in Science Award. In 2016, Dr. Achilefu was named the inaugural Michel M. Ter-Pogossian endowed professorship in radiology. He was the only candidate nationwide recommended by the Integration Panel of the Department of Defense Breast Cancer Research Program as recipient of the first Distinguished Investigator Award for his stellar innovative approaches to fundamental and applied scientific research.

At Washington University, he is the Michel M. Ter-Pogossian endowed chair in Radiology, Professor of Radiology, Biochemistry & Molecular Biophysics, and Biomedical Engineering, as well as the Chief of the Optical Radiology Laboratory, Director of the Molecular Imaging Center, and Associate Director of the Oncologic Imaging Program of the Siteman Cancer Center. Dr. Achilefu is a fellow of the SPIE (world's largest optical society), Fellow of the Academy of Science – St. Louis, Scientific Advisory Board member of the National Cancer Institute's intramural Molecular Imaging Program, consultant to the Komen Foundation, National Institutes of Health, and Department of Defense breast and lung cancer research programs. He serves as a trustee of Loma Linda University in California, Editor-in-Chief of *Current Analytical Chemistry* and on the editorial boards of the *Journal of Biomedical Optics* and *Scientific Reports*.