Photoacoustic detection of melanoma cells in vitro

Cancer is one of the leading causes of death in developed countries. Cancer constitutes a great threat to health when it becomes metastatic, i.e., when it has spread to distant parts of the body via the blood or lymph systems and has created secondary tumors. Currently, cancer is diagnosed as metastatic when the secondary tumors are large enough to be detected by conventional imaging modalities. Such secondary tumors contain billions of cells. In many cases, surgical resection of the tumors is impossible and chemotherapy is ineffective. In order to detect metastasis at an earlier stage, we have developed a photoacoustic method for detecting tumor cells in blood samples of cancer patients. Specifically, our system detects melanoma cells present in the blood system prior to becoming secondary tumors. We exploit the native light absorber, melanin, within melanoma cells to induce a photoacoustic effect, creating a robust signal indicating the presence of these circulating melanoma cells. The method employs photoacoustic excitation coupled with an optical transducer capable of determining the presence of cells within the system. The transducer is based on stress wave induced changes of optical reflectance of a glass-water interface, probed with a continuous laser beam that is incident at an angle close to the critical angle of total internal reflection. We calibrated this system using black microspheres with a diameter of 10 microns. We tested this system on a human melanoma cell line, HS 936, in microcuvettes with a detection threshold of a single melanoma cell.

John Andrew Viator entered the University of Washington in Seattle on a Naval ROTC scholarship in 1981 and received the B.S. in physics in 1985. After serving for four years on active duty as a surface warfare officer, he entered graduate school at the University of Oregon in Eugene, Oregon. He was recalled to active duty for Operation Desert Shield in 1990, where he served with the Military Sealift Command in the Persian Gulf Theater. He returned to the University of Oregon, where he earned the M.S. in mathematics in 1993. He entered the Oregon Graduate Institute of Science and Technology in 1995, where he received the M.S. in applied physics in 1997 and was awarded the Ph.D. in electrical engineering from Oregon Health & Science University in 2001. He was a postdoctoral researcher at the Beckman Laser Institute at the University of California, Irvine from 2000 to 2003. He then was awarded a Ruth L. Kirschstein NIH Postdoctoral Fellowship in the Department of Dermatology at Oregon Health & Science University. He was then offered a faculty position in the Department of Biological Engineering at the University of Missouri, where he also holds an appointment in the Department of Dermatology and is a faculty investigator in the Christopher S. Bond Life Sciences Center. He is the founder and Chief Scientific Officer of VeraPulse, LLC, a company formed to commercialize methods for early detection of metastatic cancer.

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