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SQUID chips for cancer

We have proposed the application of a high-Tc superconducting quantum interference device (SQUID) for sentinel node biopsy, which is a newly developed surgical technology. Sentinel node biopsy is used to investigate whether the sentinel node, which initially receives malignant cells from a breast carcinoma, is disease-free or not. If the sentinel node is free of disease, it is unnecessary to remove the rest of the lymph-nodes because of no concern for the progression. An infected area (primary tumor) is connected with axillary lymph nodes. In case of positive, all of the lymph nodes should be dissected because of the possibility of the progression in the future. In case of negative, you can preserve the rest of the lymph nodes. We propose a localization system combined with an ultra-sensitive SQUID magnetic sensor and iron oxide nano-particles. The particles are injected into the breast; and the high-Tc SQUID is used as a sensing detector for the particles. Male Wister Shionogi rats were used in the following experiments. The core of the particle is iron oxide Fe3O4 (magnetite) which is coated with an alkali-treated dextran. The average core diameter was 11nm. The particles had superparamagnetic properties. The particles were supplied in the form of an aqueous magnetic fluid. Signal from a rat lymph node sample was measured by a SQUID magnetic sensor. The iron content of the lymph node sample can be calculated as 10 ug, which value correspond to 0.2% of the injected iron. Although it is difficult to estimate the accumulated weight of iron particles for the human case, we think it must be more than 10ug because the volume of the injection must be 20 times larger than that of the rat. This performance is good enough to apply this system to the real sentinel lymph node biopsy.

About the speaker

Saburo Tanaka received B.E. and M.E. from Toyohashi University of Technology in 1981, and 1983, respectively. He received my Ph.D. degree in 1991 from the Osaka University, Japan. Since 1987 He has been involved in the research of high-temperature superconductors at Itami Research Laboratory, Sumitomo Electric Co., Ltd. He was engaged in the development of multi-channel high-Tc SQUID systems at the Superconducting Sensor Laboratory from 1991 to 1995. He was a visiting research associate of Prof. John Clarke's group, at the Department of Physics, University of California at Berkeley from 1996 to 1997. Currently, he is a professor in the Department of Ecological Engineering and a director of Research Center for Future Technology, Toyohashi University of Technology, Japan. He has 20 years of research experience in high-temperature SQUID applications, which extends throughout industry and academia. He is a member of the Japan Society of Applied Physics, the Institute of Electronics, Information and Communication Engineers, the Institute of Electrical Engineers of Japan, the Institute of Electrostatics Japan and IEEE in USA. He was awarded the highest prize by the SQUID 146 committee of JSPS (Japan Society for the Promotion of Science) in 2002. He has served as technical editor at numerous conferences in the field, and has published extensively in peer-reviewed journals. He has filed more than 350 patents in Japan, out of these patented inventions more than seventy were granted by the US Patent and Trademark Office.