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Recent developments in magnetic impedance biosensors and related medical devices

Early detection of cancer cells in the body greatly increases the chances of successful treatment. While traditional methods, such as visual identification of malignant changes, cell growth analysis, specific-ligand receptor labeling, or genetic testing often require lengthy analysis, a combination of ultrasensitive magnetic field sensors with functionalized magnetic nanoparticles offers a promising approach for a highly sensitive, simple, and quick detection of cancer cells and biomolecules. In this talk, I will review recent progress in the development of magnetic impedance biosensors using nanoparticles. I will present a new approach that integrates the magneto-resistance (MR), magneto-reactance (MX), and magneto-impedance (MI) effects to develop a functional magnetic biosensor with tunable and enhanced sensitivity. The MX-based probe shows the most sensitive detection of superparamagnetic nanoparticles (~10 nm diameter) at low concentrations. A novel biosensor based on the MX effect of a soft ferromagnetic ribbon with a microhole-patterned surface has been developed, demonstrating its high capacity for the detection and quantification of anticancer drugs and proteins tagged to Fe_3O_4 nanoparticles, as well as Lewis lung carcinoma (LLC) cancer cells that have taken up Fe_3O_4 or MnO nanoparticles. Finite element simulation fully supports the experimental observations. Finally, novel classes of magnetic nanostructures for advanced biosensing and new exploration in medical diagnostics will be discussed.

Biography

Manh-Huong Phan has obtained a global education with BS, MS and PhD degrees in Physics from Vietnam National University (2000), Chungbuk National (2003), and Bristol University – United Kingdom (2006), respectively. He is an Associate Professor of Physics at the University of South Florida. He has published more than 230 peer-reviewed journal papers (h-index: 37 from Google Scholar) and one text book. He is an Associate Editor for the *Journal of Electronic Materials* and the Managing Editor for the *Journal of Science: Advanced Materials and Devices*.

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