

Magneto-resistive microscope for high resolution magnetic imaging

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Immunohistochemistry (IHC) is widely used in the diagnosis of tumors, through the detection of the expression of proteins (antigens) in a tissue section by exploiting the principle of antibodies binding specifically to antigens. Visualizing an antibody-antigen interaction can be accomplished in a number of ways (eg. by using a color-producing or an antibody tagged to a fluorophore). Color-producing reactions are difficult to quantify and the localization of the color in the specimen is more diffuse as the obtained with immunofluorescence. A semi quantitative assessment of color reactions requires expensive platforms thus limiting its use to few institutions/hospitals.

This work will provide a new alternative to assess the antibody-antigen interaction for precise location of the signal in the specimen, based on robust IHC techniques but instead of color we use magnetic nanoparticles to generate the signal. Ferromagnetic nanoparticles smaller than 50 nm can be routinely synthesized and bound to secondary antibody. Therefore, the presence of a magnetic beads in a tissue is a surrogate signal of the expression of the antigen in the specimen. Scanning the surface with a magnetic sensor provides an estimation not only of the magnitude but of its localization with a high accuracy, taking profit of the excellent spatial resolution that magneto-resistive (MR) sensors offer.

The candidate will develop an integrated device with high impact for pathologists. Advanced MR sensors will be designed and microfabricated for high sensitivity field detection (few nT/sqrt(Hz)) while maintaining a small size (therefore spatial resolutions under 1 μ m). The magnetic signal of the particles on the tissue will be mapped using dedicated electronics developed for a fast, accurate detection scheme, providing a digital image of the examined tissue, with clear advantage over the conventional IHC analysis, inherently subjective, discrete and slow.

Profile sought: preference, but not limited, to students with a background in Electrical Engineering and Physics with an interest in Microelectronic design.