

The CUNY Center for Advanced Technology In Photonics Applications (CUNY CAT)
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Dipolar Field NMR Microscopy and Micro-Spectroscopy

Today Nuclear Magnetic Resonance (NMR) is a powerful analytical tool used in a variety of applications that range from imaging to molecular structure determination. However one of its main disadvantages is its limited sensitivity meaning that the amount of sample necessary to get a readable signal is invariably fairly large. As a result, the resolution currently attainable in Magnetic Resonance Imaging (MRI) or spatially resolved spectroscopy is limited to about 10 to 5 μm .

Our novel approach exploits the long-range dipole hyperpolarized semiconductor micro-tip located close

Advantages

- Minimal Sample Size
- Compatible with Standard High-Field NMR Spectrometers

Application Areas

- Localized High-Resolution Spectroscopy
- Imaging of Biological Samples

As shown in Fig. 1A, a volume of the sample comparable to the size of the tip can be selected for analysis.

After a set of radio-frequency pulses, the local nuclear spin density is detected by an optical inspection of the tip magnetization. Clearly, this principle can be used to reconstruct an image of the sample as the tip scans its surface. Inserts (B) to (D) in Fig. 1 model the performance of this technique as the tip diameter shrinks from 1000 nm in (B) to 300 nm in (C) and 60 nm in (D).

This approach can be slightly modified to also perform localized high-resolution spectroscopy or to introduce chemical or relaxation contrast in the image. In comparison with Optical Microscopy or Magnetic Force Microscopy for instance, this versatility represents a very appealing advantage, particularly in the study of biological samples where NMR is known to provide the best discrimination between different soft tissues. In addition, this system could be made fully compatible with standard commercial high-field NMR spectrometers and could thereby be provided as an optional tool.

This technology opportunity sheet describes continuing efforts in this area. Several patents may have been issued or are pending and which may be available for licensing.

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