Innovative Pulsed Magnetic Field Gradient Technique for Enhanced Nanoscale MRI

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Overview

A switchable magnetic field gradient on a tip designed to significantly enhance nanoscale MRI resolution and sensitivity achieved in modern nanoMRI sensors, which use permanent magnets. The pulsing enables faster nuclear spin manipulation and improved signal detection, making it suitable for applications requiring high-precision magnetic resonance imaging at nanometer scales. The system is compatible with cryogenic and ultra-high vacuum environments, supporting advanced quantum sensing, spintronics, and other cutting-edge nanoscale investigations.

Applications

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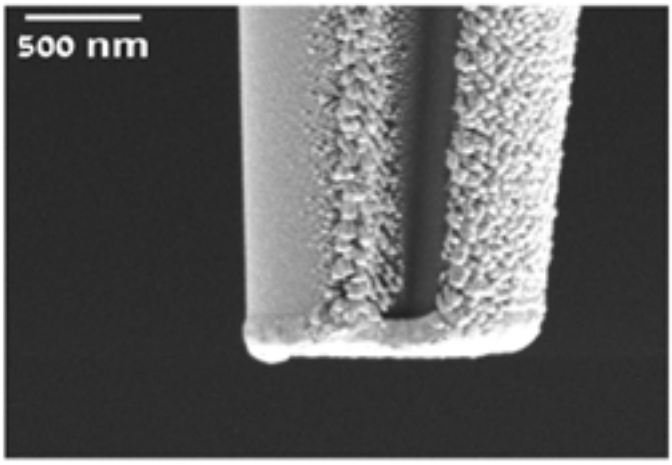
- Nanoscale MRI for research in biomedical and materials science
- Quantum sensing for precise magnetic field measurements
- Spintronics applications with controlled nuclear spin dynamics
- Advanced material characterization for semiconductors and nanomaterials
- Cryogenic imaging for low-temperature quantum experiments

Differentiation

- Simple and robust fabrication
- Short measurement time and enhanced efficiency
- Low power consumption preventing sample overheating and imaging shifts
- Highly compatible with and easily integrated into existing MRI scanning setups

Development Stage

A functional prototype has been developed and tested, demonstrating enhanced Rabi oscillation frequencies and improved spin-state control. The system is ready for further validation and integration into nanoscale MRI and quantum sensing applications.



SEM image of the sensor prototype. The quartz tip (dark region in the center) is coated with a gold microwire, through which current flows and induces a magnetic field at the apex.