NISTTech

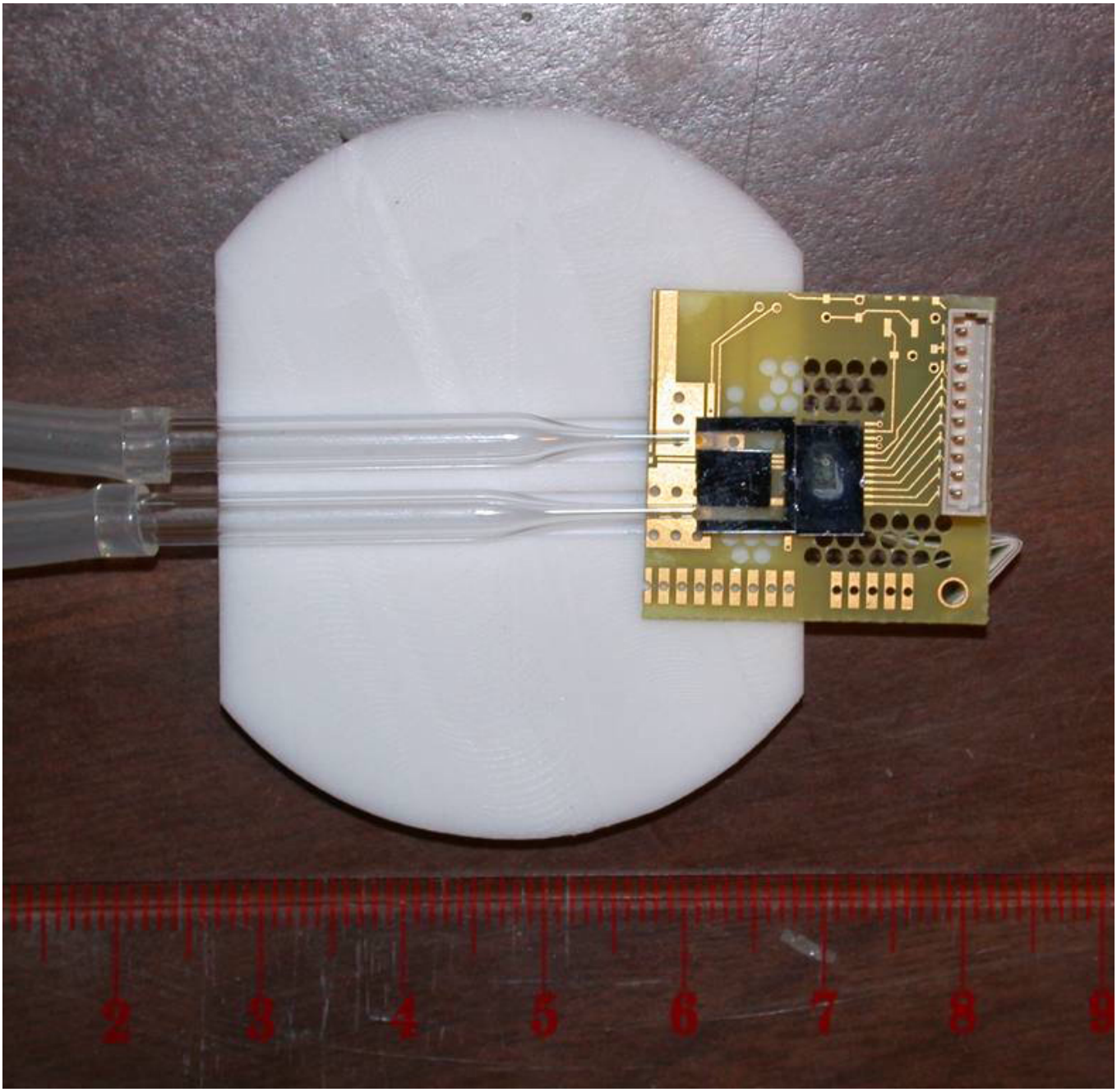
Integrated Microchip Incorporating Atomic Magnetometers and Microfluidic Channels for Detection of NMR and MRI

Economical microfluidic microchip magnetic resonance sensor to analyze very small samples

Description

This microfluidic microchip magnetic resonance sensor transports a small sample of analyte fluid to a tiny, very sensitive magnetometer detector. The detector is composed of an alkali vapor cell the size of a rice grain coupled with mini-lasers, and is able to detect very weak magnetic resonance signals from a small sample of analyte atoms. The detector is most efficient when it is very close to the sample being detected, so small size and small sample amounts work in its favor.

Images



Prototype microchip device combining NIST's miniature atomic magnetometer with a fluid channel for studies of tiny samples. Credit: NIST

Applications

- **Medical research**
  Performs feats such as tracking fluid flow through biological tissues.
- **Chemical analysis**
  Permits NMR spectroscopy.
- **Remote sensing**
  Applicable for remote sensing of environmental factors and oil exploration.

Advantages

- **Economic and versatile**
  A variety of applications may be built using MEMS fabrication techniques. Requires no expensive or bulky cryogenics.
- **Very small size**
  Economically screens minute samples of many chemicals.
- **Uses small magnetic fields**
  Noise associated with currents used to null the field are minimized and other associated benefits.

Abstract

A microfluidic chip incorporating an alkali vapor cell and microfluidic channel is described, which can be used to detect the nuclear magnetism of a polarized sample of nuclei in a fluid. Small magnetic fields in the vicinity of the vapor cell can be measured by optically polarizing and probing the spin precession in said small magnetic field. This can then be used to detect the magnetic field due to the sample of nuclei in the adjacent microfluidic channel. The nuclear magnetism in the microfluidic channel can be modulated by applying an appropriate series of radio or audio frequency pulses upstream from the microfluidic chip to yield a sensitive means of detecting nuclear magnetic resonance and magnetic resonance imaging.

Inventors

- Kitching, John
- Knappe, Svenja
- Ledbetter, Micah
- Savukov, Igor
- Budker, Dmitry
- Shah, Vishal
- Michalak, David
- Xu, Shoujun
- Pines, Alex

Citations

1. NIST Docket 08-018, A Remote Sensor Head for Chip-scale Atomic Devices

Related Items

- Atomic Devices and Instrumentation Group
- TechBeat: 'NMR on a Chip' Features NIST Magnetic Mini-Sensor

References

- U.S. Patent #7,994,783 issued 08-09-2011, expires 02/06/2029
- Docket: 08-017

Status of Availability

active patent and available for licensing

Last Modified: 03/11/2011