Researchers at the University of South Florida have invented a silicon based magnetometer which uses the spin coherence of impurities often found in silicon for magnetic field measurements.

The impurity transitions of isotopically enriched silicon can be implemented in devices for sensing magnetic fields. The current state-of-the-art magnetic field sensors exploit a wide range of physical phenomena which include inductive pick-up coils, Hall probes, magnetoresistive elements, magneto-optic devices, flux-gates and superconducting quantum interference devices (SQUIDs). Applications range from industrial, for example sensing of the position of a moving metallic component in a machine, to the detection of very weak fields produced by biological systems. Atomic magnetometers range from large, highly precise laboratory apparatus to smaller, but less sensitive instruments that can be used in the field. Magnetometers are typically characterized by their sensitivity, but also by other features such as vector or scalar operation, bandwidth, heading error, size, weight, power, cost and reliability. These characteristics determine the range of applications for which the magnetometer is suitable. The USF invention provides for a more sensitive, less expensive, and more portable device to measure magnetic fields.

The USF inventors have designed a silicon based magnetometer (Mx magnetometer) which is capable of measuring magnetic fields based on direct optical measurement of the Larmor precession frequency of impurities most commonly found in silicon. The impurities can be donors or acceptors and elements such as phosphorous P and bismuth Bi are very suitable.

ADVANTAGES:
- More sensitive, less expensive and more portable
- Exceeds the sensitivity of SQUID magnetometers at low temperatures
- No need for photodetectors
- Great improvement in the signal-to-noise ratio

Magnetic Field Measurement System

Schematic Describing the P impurity Center with its Associated Bound Exciton

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