Gas Sensors Based on Diamond Nitrogen Vacancy Centers

A highly stable, miniature, and long-lifespan sensor uses electron spin resonance of nanodiamond centers to accurately calculate air pressure for diverse gas sensing applications.

Gas sensing, especially oxygen sensing, is important in many fields, ranging from the sensing of automobile exhaust gas to improve vehicle efficiency and reduce air pollution, to the analysis of the breathing gases used by scuba divers. Current methods for the detection of gases include zirconia sensors and fluorescence-based sensors. Each of these sensors have a variety of drawbacks including size, tightly constrained operating conditions, and short lifespans.

Researchers at Purdue University have developed a new method for gas sensing that uses air pressure dependent, electron spin resonance (ERS) of nanodiamond nitrogen-vacancy centers to calculate air pressure. This method works because when a nitrogen-vacancy center is formed in a nanodiamond, the unpaired electrons left behind began to spin. The spin of these unpaired electrons can be analyzed and is directly correlated to ambient air pressure. As a result, air pressure can be calculated by an extremely small sensor that is only a few nanometers across or as large as a few centimeters, making it flexible for many different applications. It can operate under a large range of temperatures and has a much longer lifespan than current gas sensors.

Advantages:

-Can operate from absolute zero to 800K

-As small as a few nanometers

-Extremely stable, leading to a long lifespan

Potential Applications:

-Oxygen gas sensing

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Category

Materials Science & Nanotechnology/Nanomaterials & Nanostructures

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-Optical trapping

-ESR in vacuum conditions

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