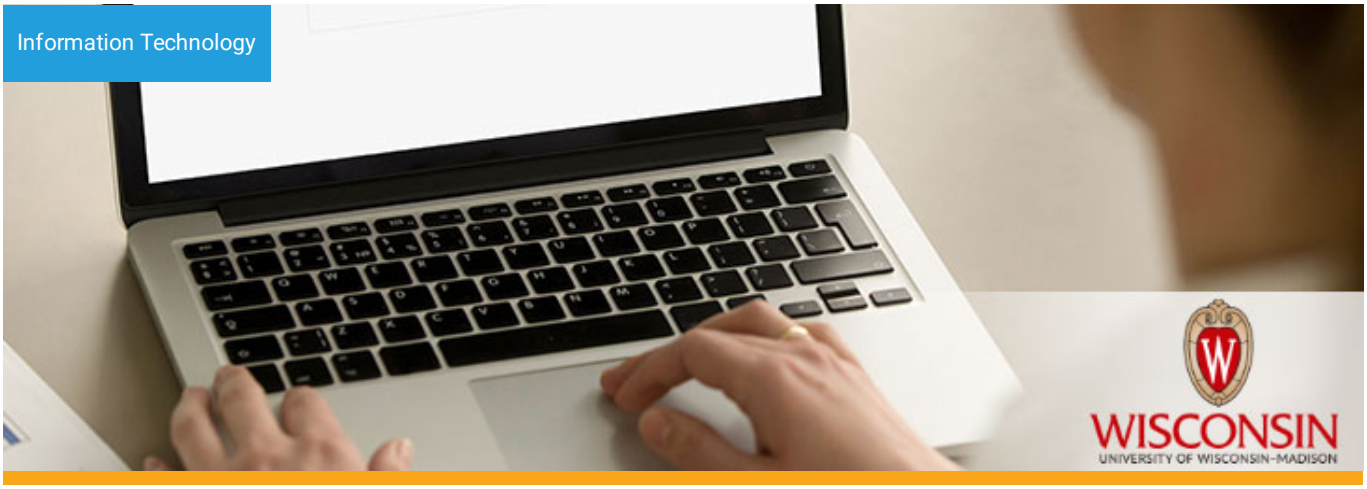
Information Technology



Bringing Quantum Computers Closer to Reality by Solving Decoherence Problem

View U.S. Patent No. 9,437,800 in PDF format.

WARF: P150095US01

Inventors: Robert McDermott, Pradeep Kumar

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method for suppressing excess magnetic flux noise in superconducting quantum circuits.

Overview

A quantum computer will allow efficient solutions for certain problems that are intractable on conventional, classical computers, including factoring and quantum simulation of complex systems. While a classical bit can represent either logical 0 or logical 1, a quantum bit ("qubit") can exist in a superposition of these logical states. The ability to perform operations on large-scale superpositions and entangled states provides a quantum computer with unparalleled computing power compared to a classical machine.

In any physical realization of a quantum computer, it is critical to protect the qubit register against decoherence, or unwanted information loss due to coupling of the qubits to their environment. Here, the environment includes not only external measurement and control circuitry, but also microscopic defect states that could perturb qubit operation. In the area of superconducting qubits, many possible sources of decoherence have been identified and studied in detail. Continued progress in the superconducting quantum information field demands robust approaches to the suppression of qubit decoherence.

The Invention

UW–Madison researchers have developed a system and method for reducing noise from magnetically active surface defects, a dominant contributor to decoherence in superconducting quantum circuits.

The researchers found that adsorbed molecular oxygen represents a major source of magnetic noise. As a result, they have developed approaches to hermetically package qubit samples in an improved vacuum environment. The developed hermetic sample enclosure prevents the adsorption of a high density of magnetically active defects on the surface of the device during cooldown. The surfaces of encapsulated devices show greatly reduced levels of magnetic activity and low-frequency magnetic flux noise.

Other tactics for reducing noise may be employed as well, such as passivating the device surface with a high density of non-magnetic adsorbates, coating the circuits with a protective non-magnetic layer or irradiating the device with ultraviolet light to drive off magnetically active adsorbates.

Applications

- Hardware for superconducting quantum computers

Key Benefits

- Brings superconducting quantum computers closer to reality
- Reduces decoherence problem that has stymied quantum computing technology for decades

- Allows realization of frequency-tunable superconducting qubits with improved dephasing times

Stage of Development

Preliminary experiments have been completed and the invention has been shown to reduce magnetic activity and low-frequency flux noise in Superconducting Quantum Interference Devices (SQUIDs); see Kumar et al., arXiv:1604.00877 (2016).

Additional Information

For More Information About the Inventors

- Robert McDermott

Related Technologies

- WARF reference number P140246US01 describes a novel qubit measurement system based on counting microwave photons.
- WARF reference number P140260US01 describes a system to control superconducting quantum circuits using single flux quantum logic.

Publications

- Kumar P., Sendelbach S., Beck M. A., Freeland J. W., Wang Z., Wang H., Yu C. C., Wu R. Q., Pappas D. P. and McDermott R. 2016. Origin and Suppression of 1/f Magnetic Flux Noise. arXiv:1604.00877 [cond-mat.supr-con]

Tech Fields

- Information Technology : Hardware

For current licensing status, please contact Emily Bauer at emily@warf.org or 608-960-9842