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Optical Interconnect System for Logic Systems and Spin-Based Computation (20140063, Dr. Jian-Ping Wang)

Technology No. 20140063

Data Transfer Using Spintronics

An optical interconnect can be used as the interconnect in spin-based computation and logic systems. The spin-optical interconnect scheme consists of a spin-to-optical transmitter and an optical-to-spin receiver, which are connected with multichannel, integrated optical waveguides or fibers. For data transmission, a spin-based signal is converted to an optical signal and transmitted via an optical transport (e.g., optical fiber and optical waveguide). For data reception, the optical signal is received via the optical transport and converted back to a spin-based signal. Such data transfer may not require an intervening conversion of spin-based signals to charge-based signals that rely on voltages or currents to represent digital bit values, as the technique uses digital bit values represented by magnetization states of magnetoresistive devices rather than voltages or currents.

IC and CMOS Limitations

Performance and efficiency of charge-based large scale integrated circuits (ICs), such as those based on a complementary metal-oxide-semiconductor (CMOS) platform and architecture, are hindered by power consumption and bandwidth limitation in electrical interconnects. Spin-based systems in general can potentially address the limitations of charge-based electrical systems based on CMOS ICs at least with respect to power and architectural constraints of transmitting digital bits at higher data rates. This optical interconnect approach offers several advantages over current electrical interconnects in integrated circuits: low power consumption, high bandwidth, low heat generation and low cross-talk and interference.

BENEFITS AND FEATURES:

- Optical interconnect as the interconnect in spin-based computation and logic systems low power consumption
- Spin-to-optical transmitter and an optical-to-spin receiver

- Digital bit values represented by magnetization states of magnetoresistive devices rather than voltages or currents
- High bandwidth
- Low heat generation
- Low cross-talk and interference
- Optical signal transmitted through the optical waveguides integrated on a chip over a medium distance (tens of microns to a few millimeters), or through optical fibers over a very long distance (more than tens of millimeters)

APPLICATIONS:

- Computation
- Communication
- Logic systems
- CMOS
- Integrated circuits (IC)

Phase of Development - Proof of Concept, or Prototype of component level

Researchers

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Publications

All-Optical Switching of Magnetic Tunnel Junctions with Single Subpicosecond Laser Pulses
Physics Review Applied, 7, 021001; February 2017

External Links

C-SPIN Lab