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Amplification effect of low-field magnetoresistance in silicon dual $p-n$ junctions DEZHENG YANG, TAO WANG, MINGSU SI, FANGCONG WANG, Key Laboratory for Magnetism and Magnetic materials of Ministry of Education, Lanzhou University, Lanzhou 730000, China, SHIMING ZHOU, Department of physics, Tongji University, Shanghai 200092, China, DESHENG XUE, Key Laboratory for Magnetism and Magnetic materials of Ministry of Education, Lanzhou University, Lanzhou 730000, China — Nonmagnetic semiconductors with large magnetoresistance are identified as promising feature for the development of magnetoelectronics. However, to manipulate the magnetoresistance require the magnetic field of several Tesla. In this work, we realized an amplification effect of low-field magnetoresistance based on an elementary electronic building block: dual $p-n$ junction. Analogous to the electrical amplification effect of transistor$p-n-p$ junction, where the coupling current between$p-n$ and $n-p$ junctions is tuned by base current, in a silicon $p+-n-n+$ device we demonstrate that the coupling strength of $p+-n$and $n-n+$ junctions can be tuned by magnetic field. Owing to the amplification effect of magnetic-field-manipulated coupling, at a small magnetic field from 0 to 0.1 T the device is directly switched from conducting state "on" (10000 ohms) to blocking state "off" (5 megohm), yielding an magnetoresistance of 50,000 per cent and magnetic field sensitivity as high as 50 per cent Oe^{-1}. Such a combination of magnetoresistance and high sensitivity not only makes the semiconductor device available in the magnetic field sensing industry, but also permits a new kind of magnetic-field-manipulated semiconductor electronics.

Key Laboratory for Magnetism and Magnetic materials of Ministry of Education, Lanzhou University, Lanzhou

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