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Vertical spin transport in MnAs/barrier/GaMnAs heterostructures

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Electrical spin injection and detection across metal-semiconductor interface is an important step for practical semiconductor spintronic devices. However, the problem of huge conductance mismatch between metals and semiconductors prohibited the progress. Thereby, intensive studies were carried out to find ways to overcome this problem. The use of tunneling or Schottky barrier is one of them and turns out to be quite successful. For example, AlAs tunneling barrier at MnAs/GaMnAs interface or GaMnAs/GaMnAs interface allows efficient spin-polarized tunneling [1][2].

We have studied the effect of barrier structure and strength on the tunneling magnetoresistance (TMR) in MnAs/GaMnAs heterostructures separated by single or double AlAs barriers. The epitaxial structures were grown by low-temperature molecular beam epitaxy. The vertical magnetotransport properties were studied over a wide range of temperatures.

We find that the junction resistances of both single and double barrier samples increase exponentially as the barrier strength increases, implying that tunneling process governs the transport properties. In contrast, the tunneling magnetoresistance depends primarily on the number of interfaces rather than on the barrier strength. We discuss the implications and compare with the results of GaMnAs/barrier/GaMnAs structures.

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