Direct Measurement of the Spin Polarization of the Magnetic Semiconductor (Ga,Mn)As. Comment

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Comment on "Direct Measurement of the Spin Polarization of the Magnetic Semiconductor (Ga,Mn)As"

In a recent Letter, Braden *et al.* report on the direct measurement of the transport spin polarization of the magnetic semiconductor $Ga_{0.95}Mn_{0.05}As$ based on the conductance-voltage (dI/dV-V) relation of a $Ga_{0.95}Mn_{0.05}As$/Ga junction [1]. The junction shows a large suppression of the subgap conductance, which they attribute to a suppression of Andreev reflection due to a degree of spin polarization of 85%. Although we are aware that this high degree of spin polarization is in accordance with tunnel magnetoresistance [2] and recent spin–light-emitting-diode experiments [3], we question their interpretation of the conductance-voltage relation. We point out that the suppression of the subgap conductance is not necessarily caused by a high degree of spin polarization, but can, in the case of tunneling dominated transport, reflect a poorly developed superconducting density of states of the Ga film.

Andreev reflection spectroscopy leads to a meaningful determination of spin polarization only when the transport across the interface is strictly metallic and the superconductor possesses a well-developed BCS-like density of states. In the case of a metallic interface, the subgap conductance induced by Andreev reflection is suppressed by the spin polarization of which the degree can easily be extracted using the modified Blonder-Tinkham-Klapwijk theory [4]. Transport governed by tunneling processes is reflected by a suppression of the subgap conductance simply due to the gap in the superconducting density of states and the absence of Andreev reflection, and not necessarily due to spin polarization of the carriers. Accordingly, when tunneling processes are not properly identified, suppression of the subgap conductance may be incorrectly attributed to a degree of spin polarization. Unfortunately, Braden *et al.* spent minor attention on this crucial issue. They mention only that the current-voltage relation above the superconducting transition temperature is linear, which in their opinion indicates the absence of a Schottky barrier. We stress that a linear current-voltage relation is not a sufficient requirement for the absence of a Schottky barrier. For a doped GaAs-metal interface it is well known that a Schottky barrier is formed and that the current-voltage relation appears linear for sufficiently thin barriers obtained with high doping levels [5].

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