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Tunnel magnetoresistance and current-induced magnetization switching in mesoscale (Ga,Mn)As magnetic tunnel junctions M.J. WILSON, P. MITRA, M. ZHU, P. SCHIFFER, N. SAMARTH, Dept. of Physics, Penn State University, University Park. , L. XUE, K.V. THADANI, D.C. RALPH, Dept. of Physics, Cornell University, Ithaca., M.E. FLATTE, Dept. of Physics, University of Iowa, Iowa City. — We report measurements of the tunneling magnetoresistance (TMR) and current-induced magnetization switching in exchange-biased (Ga,Mn)As/GaAs/(Ga,Mn)As magnetic tunnel junctions (MTJs) with dimensions in the mesoscale regime ($2 - 10\mu m^2$). We observe thermally activated quenching of the TMR over two decades in temperature (0.35 K$< T <$40 K), characterized by a functional form: TMR(T) = TMR(0)[$1 - \exp(-T_0/T)$], with $T_0 \sim 10$ K. This behavior is interpreted using a model in which tunneling is dominated by the hole state bound to a Mn spin in the depletion region near the (Ga,Mn)As/GaAs interface. For $T < T_0$, such spins have a preferred orientation relative to the "bulk" ferromagnetic region, but at higher temperatures they become decoupled from the latter. We also discuss experiments that probe current-induced magnetization switching in these mesoscale devices. We find that in addition to complete switching between high- and low-resistance states of a MTJ, current pulses can lead to stable, intermediate resistance states, possibly due to fragmentation into multiple magnetic domains by heating. Supported by ONR-MURI.

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