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From ballistic transport to tunneling in electromigrated ferromagnetic breakjunctions KIRILL BOLOTIN, F. KUEMMETH, A.N. PASUPATHY, D.C. RALPH, Cornell University — We fabricate ferromagnetic constrictions whose cross section can be reduced gradually from 100×30 nm^2 to the atomic scale and eventually to the tunneling regime by means of electromigration. The contacts are attached to non-magnetic substrates and are measured at 4.2 K, so they are much more mechanically stable than previous room-temperature studies. We measure magnetoresistances (MR) $< 3\%$ for contacts $< 400\ \Omega$, consistent with previous experiments. As the contact diameter is reduced in the range 400 Ω - 25 kΩ, we observe reproducible non-monotonic changes in the MR. We find first a minimum in the MR and sometimes a change in sign to small negative values, and then a strongly increasing positive MR as the contact approaches the atomic scale ($\sim$ 25 kΩ). For near-atomic-sized constrictions the maximum MR is 80%. Measurements as a function of the direction of applied magnetic field allow us to separate the contribution of anisotropic magnetoresistance from the MR due to a domain wall. In the tunneling regime the MR fluctuates over a wide range, -10% to 85%, even for small changes in the atomic structure in a single device.

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