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Tunable magnetoresistance driven by magnetically sensitive negative differential resistance in an asymmetrically coupled single molecule junction BEN WARNER, FADI EL HALLAK, UCL, UK, JOHN SHARP, MATS PERSSON, University of Liverpool, UK, ANDREW J. FISHER, CYRUS F. HIRJIBEHEDIN, UCL, UK — Using scanning tunneling microscopy, we study the effects of interactions between individual magnetic molecules that are separated from an underlying copper surface by a thin-insulating layer of copper nitride (Cu_2N). For electrical transport through a junction containing an individual iron phthalocyanine (FePc) molecule on Cu_2N, we observe two novel magnetoresistance behaviors that arise from negative differential resistance (NDR) that shifts by unexpectedly large amounts in a magnetic field. Because voltage is dropped asymmetrically in this double barrier junction, the FePc can become transiently charged when its states are aligned with the Fermi energy of the Cu, resulting in the observed NDR effect. Furthermore, the asymmetric coupling magnifies the observed voltage sensitivity of the magnetic field dependence of the NDR - which inherently is on the scale of the Zeeman energy - by almost two orders of magnitude. These findings represent a new basis for making magnetoresistance devices at the single molecule scale. Furthermore, the enhancement of the energy scales created by asymmetric coupling of the junction can be combined with other multi-step tunneling processes to allow for the investigation of other phenomena that normally would be difficult to observe.

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