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Supporting Information

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On-Chip Magnetic Platform for Single-Particle Manipulation with Integrated Electrical Feedback

Marco Monticelli, Andrea Torti, Matteo Cantoni, Daniela Petti,* Edoardo Albisetti, Alessandra Manzin, Erica Guerriero, Roman Sordan, Giacomo Gervasoni, Marco Carminati, Giorgio Ferrari, Marco Sampietro, and Riccardo Bertacco*

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Magnetic simulations by OOMMF

The magnetic simulations illustrated in Figure 2 a-c and Figure 3 are performed with the software OOMMF (Object Oriented Micro Magnetic Frameworks) [D.M.J Donahue, 1999 OOMMF User's Guide, Version 1.0. interagency Report NISTIR 6376.3, 2004]. The physical space is modeled with a cubic elementary cell of 10 nm x 10 nm x 10 nm. The unit cell dimension is a good trade-off between the requirement of not exceeding the Permalloy exchange length (5.3 nm) [G.S. Abo, T.K. Hong, J. Park, J. Lee, W. Lee, B.C. Choi, "Definition of Magnetic Exchange Length" IEEE Trans. Magnetics, 49(8): 4937-4939, 1979] and limiting the computational time. The damping coefficient is set to the default value of 0.01, which ensures an enough fast convergence to the equilibrium state. Typical parameters for $Ni_{80}Fe_{20}$ are used: saturation magnetization $Ms=860\cdot10^{3}$ A/m, exchange stiffness constant $A=1.3\cdot10^{-11}$ J/m and no magneto-crystalline anisotropy is considered.

Variation in electrical conductivity due to AMR

As discussed in the main text, a magnetotransport model [A. Manzin, V. Nabaei, H. Corte-León, O. Kazakova, P. Krzysteczko, H. W. Schumacher. Modeling of anisotropic magnetoresistance properties of permalloy nanostructures, *IEEE Trans. Magn. 50*, **2014**, 7100204] in combination with a micromagnetic solver [O. Bottauscio, A. Manzin. Parallelized micromagnetic solver for the efficient simulation of large patterned magnetic nanostructures. *J. Appl. Phys.* **2014**, *115*, 17D122.] are used to simulate the electrical behaviour of a magnetic zig-zag shaped conduit, in order to evaluate its AMR. For the employed geometry, the values of the electrical conductivity in presence and absence of a transverse DW at the measurement corner are illustrated in figure S1. The maximum value for the conductivity is around 3 MS/m when a DW is pinned at the corner and decreases to 2.94 MS/m when the DW is displaced away.

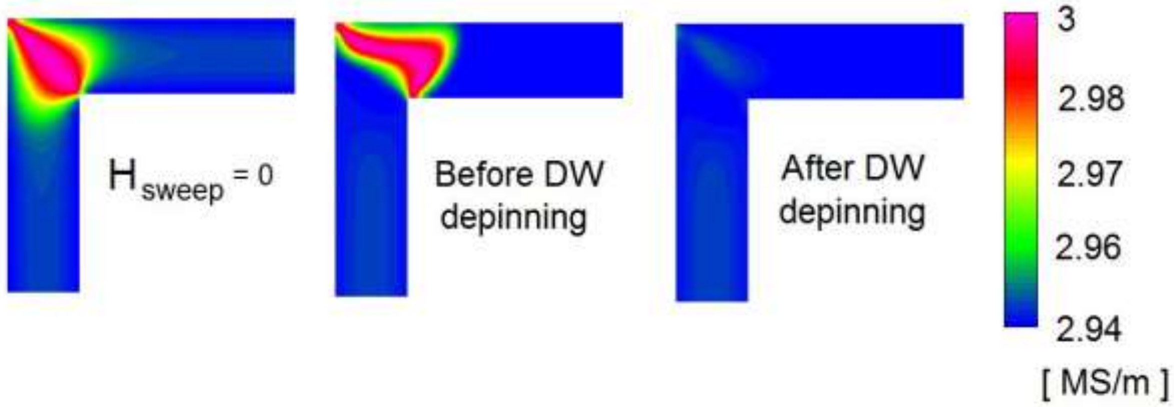

Figure S1. Simulated map of the electrical conductivity at the Permalloy corner (200 nm wide and 30 nm thick) at remanence (left), just before (middle) and after (right) the depinning of a transverse DW nucleated at the corner of the nanostructure. The conductivity increases when the DW is located at the corner for the anisotropic magneto resistance effect.