Supplementary materials for: *Scanning nitrogen-vacancy center magnetometry in large in-plane magnetic fields*

P. Welter, J. Rhensius, A. Morales, M. S. Wörnle, C.-H. Lambert, G. Puebla-Hellmann, P. Gambardella and C. L. Degen

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1 Magnet assembly

For the scanning NV measurements, we use a custom-designed assembly for applying an in-plane magnetic field. A drawing is shown in Fig. S1.

2 Coercive field of Co-NiO sample

We measure the sample coercivity by exploiting the planar Hall effect (PHE). The planar Hall effect describes the appearance of a charge accumulation perpendicular to the current flow, that is maximized when the angle between the in-plane magnetization and the current is 45°. We sweep the magnetic field strength parallel to the probe current. At saturation, the PHE contribution is zero. At the coercive field, the sample will spawn domains with a magnetization at an angle with the field, with a net contribution to the PHE voltage.

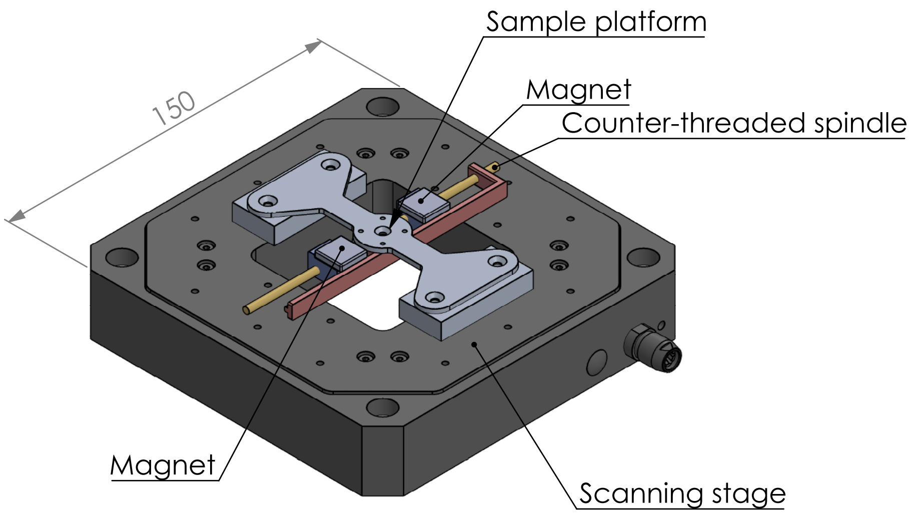

Figure S1: Drawing of the magnet assembly. The sample is placed in the center of the platform. Two small permanent Neodymium magnets are glued each to a carriage that rides on a rail (red). The rail is fixed to the sample platform by a rotary slip-joint. The distance between the sample and the magnets can be moved by rotating a counter-threaded spindle. The magnets' poles are facing along the rail. This way, one can adjust both the angle of the in-plane field (by rotating the magnets around the sample) and its magnitude (set by the distance of the magnets to the sample). All components are made from non-magnetic materials (plastic, aluminium, stain-less steel) to avoid distorting the field.

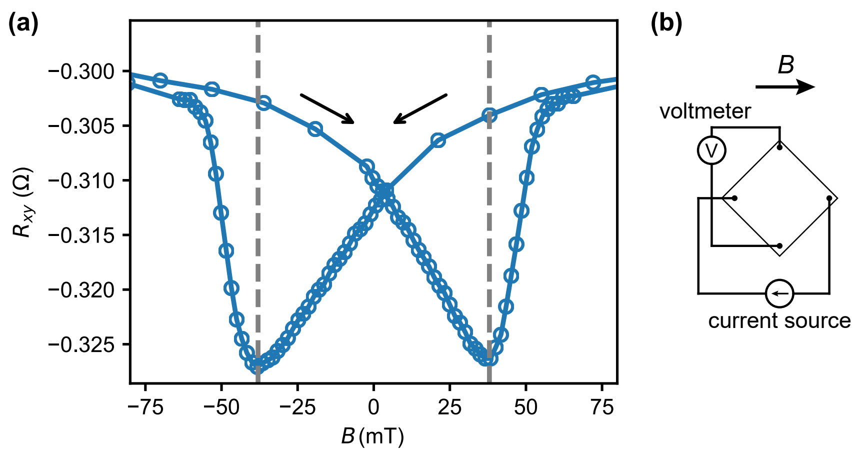

Figure S2: Measurement of coercivity of NiO-Co sample by planar Hall resistance. **(a)**The dips (marked by the dashed lines, at $\pm 38\,\mathrm{mT}$) correspond to the coercive field. Arrows show the direction of the field sweep. **(b)** Schematic diagram of the measurement. A current is applied parallel to the magnetic field. The Hall voltage is measured perpendicular to the current flow.