SUPPLEMENTARY FILES:

Supplement materials and methods:

Synthesis

The Stöber reaction¹⁹ was used with the following concentration as standard conditions: $[H_2O] = 1.0 \text{ M}, [NH_3] = 0.8 \text{ M}, [TEOS] = 0.1 \text{ M}, and [Cells] = 1.0 grams/l in a total volume of$ 100 mL of ethanol. The reactant concentrations were reduced to test the respective effect onthe amount of free silica particles. However, as it was difficult to obtain bacteria without thepresence of remaining water, it was difficult to quantify the ratio between coating and freesilica particles and to connect this parameter to the given concentration of the reactant.The Nomura protocol was then followed.¹⁰ Briefly, the cells were centrifuged 3 times with 0.9w/v % NaCl solution for 15 minutes at 9,000 RPM, 4°C (resuspension with 40 mL ofammonia ethanol). The cells were placed in a conical flask with the necessary amount ofdeionized water and sonicated for 15 minutes. Ethanol and TEOS were added to the flask andthe mixture was left for 72 hours with magnetic stirrer. The product was then isolated by 10minute centrifugation at 3500 rpm, washed with deionized water and ethanol, and leftovernight in a dessicator with silica gel. The product was finally heated for 3 hours at 600 °Cfor calcination.

Scanning Electron Microscopy (SEM)

Images were obtained either on a LEO 1550 (low resolution images) or on a JEOL 7500 F (high resolution images). The JEOL machine is also equipped with a TEM detector and thus combined SEM / TEM images could be obtained from this machine.

Transmission Electron Microscopy (TEM)

Images were recorded on a Zeiss EM 912 Omega at 120 kV. Thin cut were prepared by embedding the samples first.

Synchrotron X-ray Diffraction (XRD)

XRD measurements were performed at the μ -spot beamline at the BESSY II synchrotron radiation facility (Helmholtz-Zentrum Berlin (HZB), Germany), in transmission geometry, with an energy of 15 keV, defined by a silicon (111) double-crystal monochromator and a beam size of 100 μ m.

FMR spectroscopy

FMR spectra were recorded at 9.4 GHz (X-band) on a Bruker CW Elexsys E500 spectrometer.

Determination of the FMR spectral parameters

The effective splitting factor (g_{eff}) and the asymmetry ratio (A) are used to describe the properties of a sample.²¹ These parameters are calculated as follow:

$$g_{eff} = \frac{h \times v}{\mu_B \times B_{eff}}$$

and

$$A = \frac{\Delta B_{high}}{\Delta B_{low}}$$

where $B_{eff} \Delta B_{low}$ and ΔB_{high} are defined as on figure S3. The splitting factor depends on the effective field at which the maximal resonance (or a zero in the first derivative plotting) is obtained. The asymmetry ratio, as indicated by its name, depicts the extension of the spectrum towards the high or the low fields respectively.

Hysteresis and FORC analysis

Hysteresis loop, backfield remanence and first order reversal curve (FORCs) have been measured with the AGM (Princeton Measurements Corporation, Alternating Gradient Force Magnetometer Micro-Mag Model 2900). Hysteresis loops have been performed in a magneic field from +1 T to -1 T. Each loop is normalized by mass (including Si coating) and is adjusted for 70% diamagnetic and paramagnetic corrections. Measurements of backfield isothermal remanence curve, which measures the remanent coercivity (H_{cr}), have been made in a field from 0 to 1 T with a field increment of 5 mT. For FORC diagrams, 140 partial hysteresis curves have been measured, using a saturation field of 1 T and measurement increment of 2.6 mT, and is analysed with M.Winklhofer MATLAB code.²⁹ Each data point is measured at 100 ms (averaging time) in all measurements.

Supplement figures:



Figure S1: thin cut of the materials imaged by TEM.



Figure S2: normalized hysteresis measurements.



Figure S3: figure showing how the FMR spectral parameters are determined.

Supplement Film

Film F1: resuspended materials in a varying external magnetic field.