Supplementary Information

The Role of Superlattice Phases and Interparticle Distance in the Magnetic Behaviour of SPION Thin Films

Marion Görke,[a] Sherif Okeil,[a] Guohui Yang,[b] Herrmann Nirschl,[b] Thilo Viereck[c,d] and Georg Garnweitner*[a,c]

a: Institute for Particle Technology (iPAT), Technische Universität Braunschweig, Volkmaroder Straße 5, 38106 Braunschweig, Germany

b: Institute of Mechanical Process Engineering and Mechanics (VM), Karlsruhe Institute of Technology, Straße am Forum 7, 76131 Karlsruhe, Germany

c: Laboratory for Emerging Nanometrology (LENA), Technische Universität Braunschweig, Langer Kamp 6 a/b, 38106 Braunschweig, Germany

d: Institute for Electrical Measurement Science and Fundamental Electrical Engineering (emg), Technische Universität Braunschweig, Hans-Sommer-Str. 66, 38106 Braunschweig

Additional Information for the GISAXS data evalution

Data reduction and merging steps: The following procedure was used to obtain final 1D scattering curves from the multi-distance GISAXS data:

1. **Geometric Correction**: Apply the wedge correction to each 2D GISAXS frame to correct for the incident-angle geometry and ensure all intensities are on an equal footing for integration.
2. **1D Linecut Integration**: For each corrected 2D pattern, perform a horizontal linecut through the Yoneda region (constant qz) to extract the intensity profile I versus q (with q aligned with the in-plane direction, see below). A small range of pixels around the Yoneda peak was averaged to smooth out noise, yielding a single representative curve per detector distance.
3. **Merging of q-Ranges**: Calibrate and combine the 1D profiles from different sample-to-detector distances into one continuous curve. The intensity profiles were scaled in their overlapping q-intervals so that they superimpose, then merged to produce a composite 1D scattering curve covering q = 0.003–0.2 $Å^{-1}$. This merging leverages the low-q data from long distances and high-q data from short distances to extend the overall accessible q-range.
4. **Guinier Analysis**: The merged 1D scattering curve (intensity I vs. q) was analyzed to determine characteristic size parameters of the scattering objects or structural domains. In particular, the low-q region of the curve was fitted using the Guinier approximation (using Equation 5 in our paper) to estimate the particle radius of gyration or correlation length. The Guinier law (ln I vs q^2 linearity at small q) provides an estimate of the average size of the scattering features, either corresponding to particle dimensions or periodicity in the sample (as appropriate, depending on the form of the scattering curve).

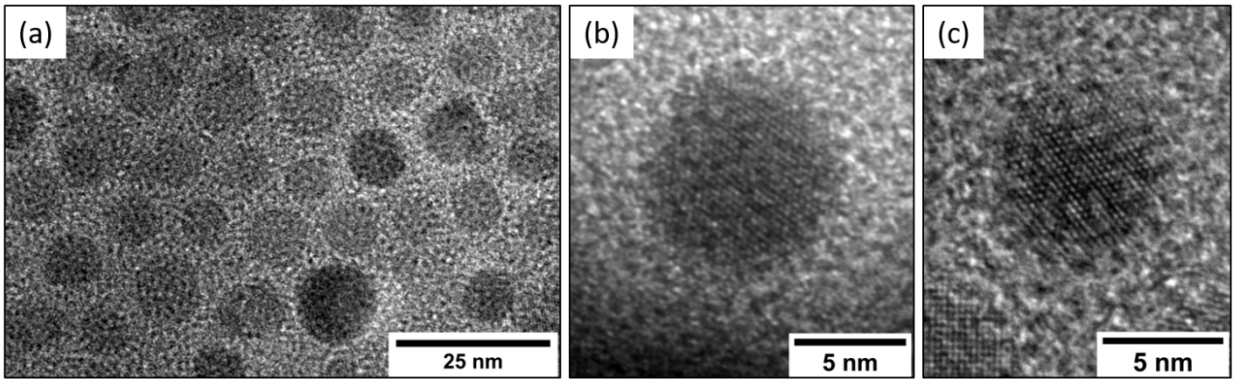

Figure 1: TEM micrographs of the particles with the ligand systems 4 mmol SAc (a, b) and 12 mmol SAc (c).

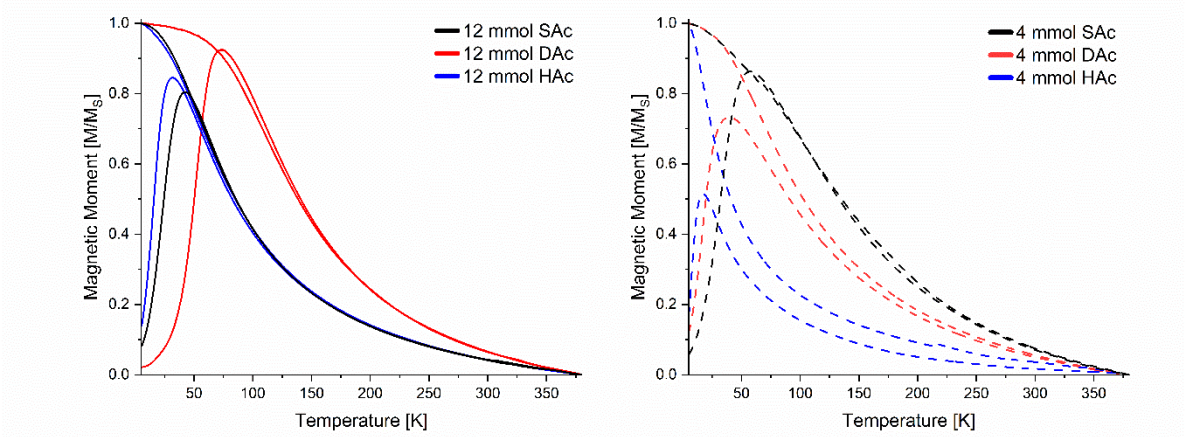

Figure 2: zfc/fc curves for the thin film samples with a high ligand concentration (left) and low ligand concentration (right).

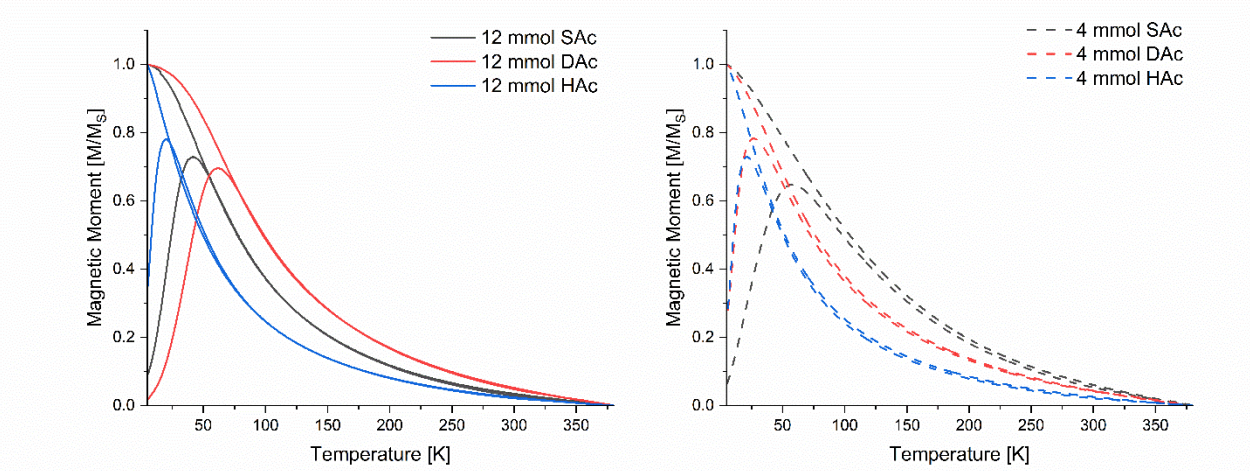

Figure 3: zfc/fc curves for the capsule samples with a high ligand concentration (left) and a low ligand concentration (right).

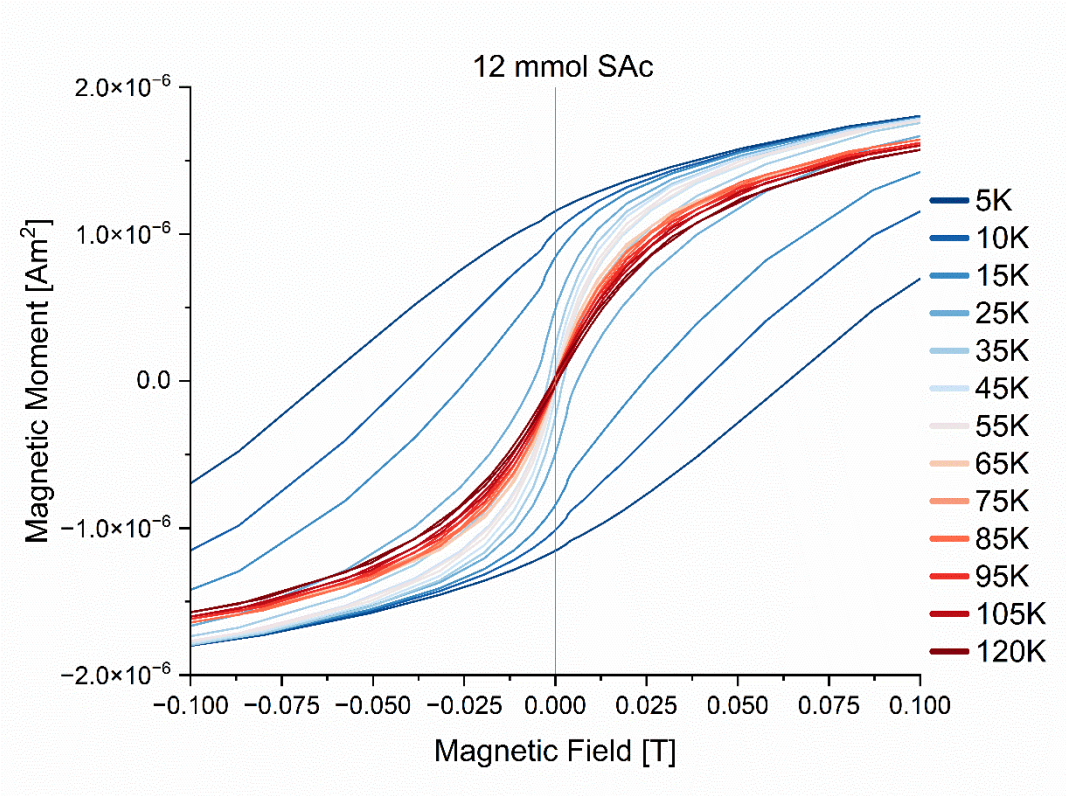

Figure 4: M(H) curves at various temperatures for the 12 mmol SAc thin film sample.

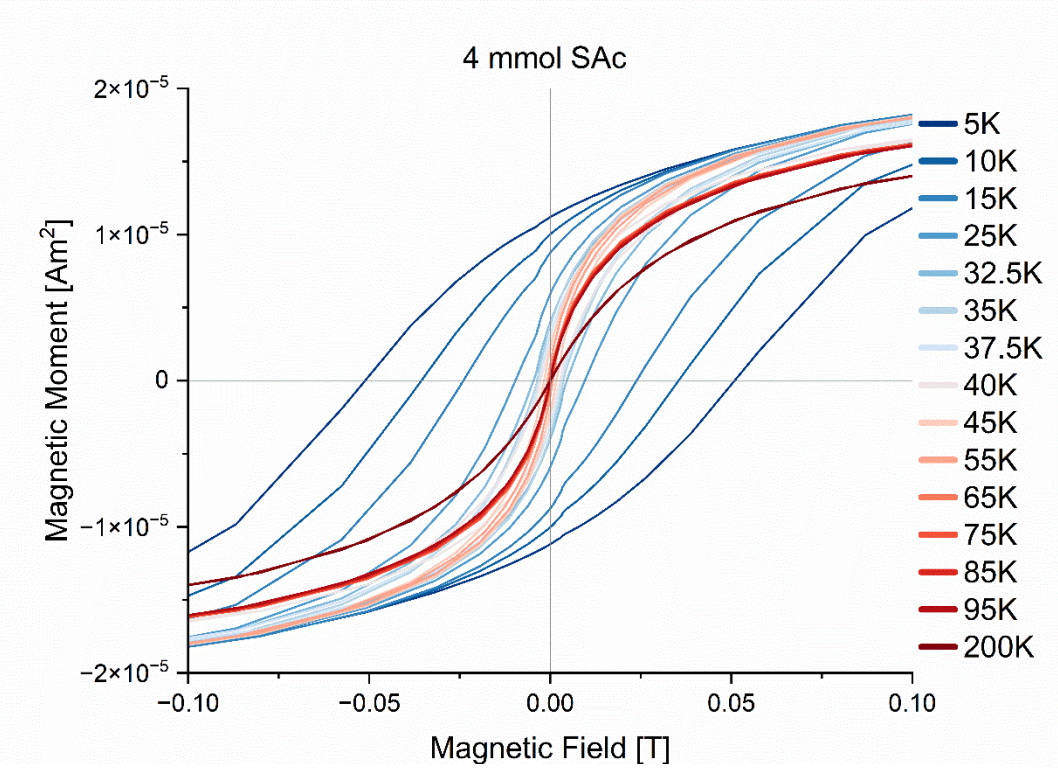

Figure 5: M(H) curves at various temperatures for the 4 mmol SAc thin film sample.

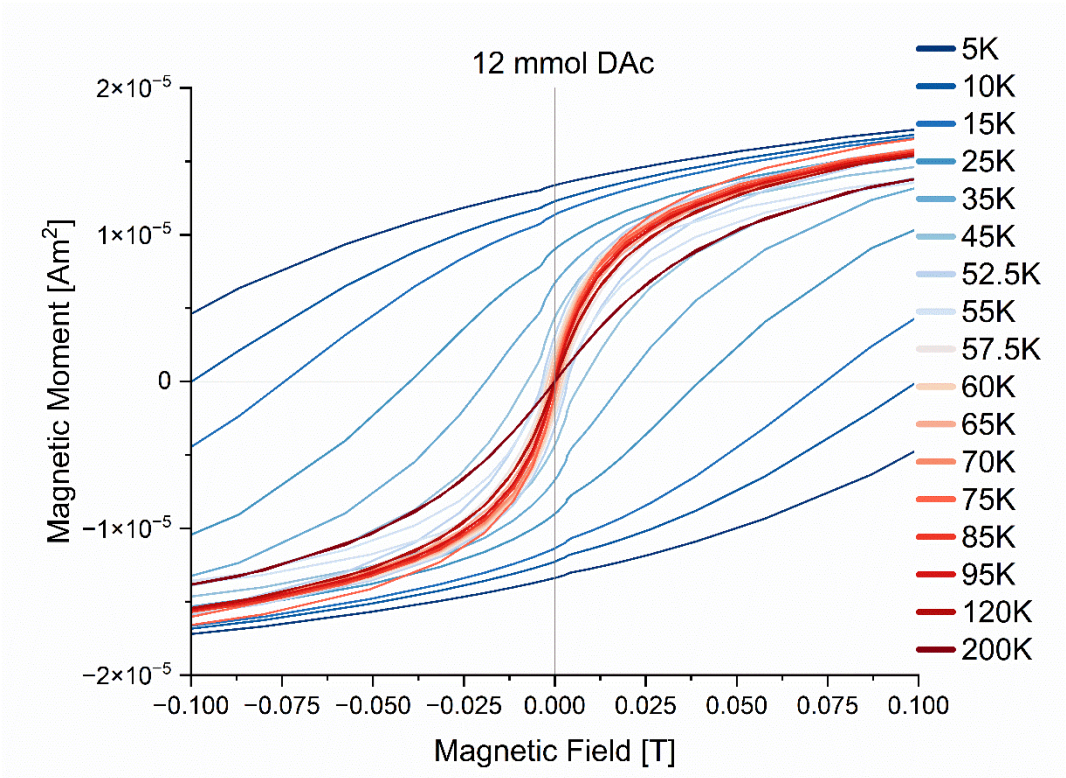

Figure 6: M(H) curves at various temperatures for the 12 mmol DAc thin film sample.

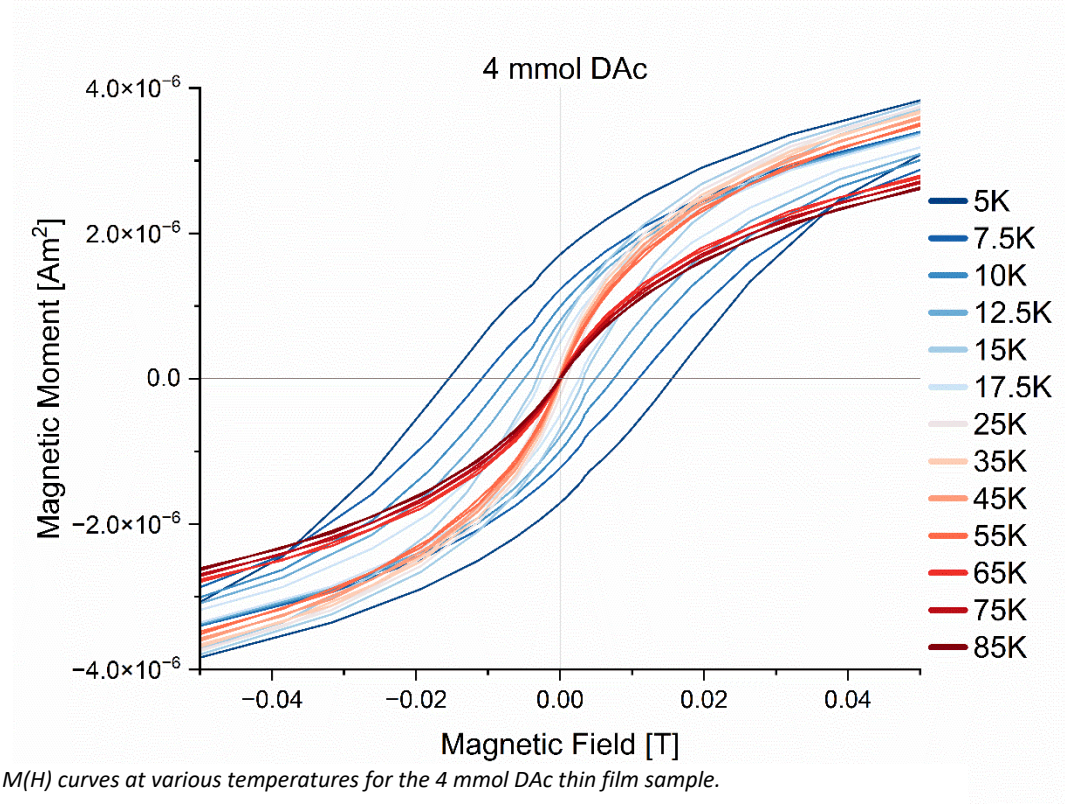

Figure 7: M(H) curves at various temperatures for the 4 mmol DAc thin film sample.

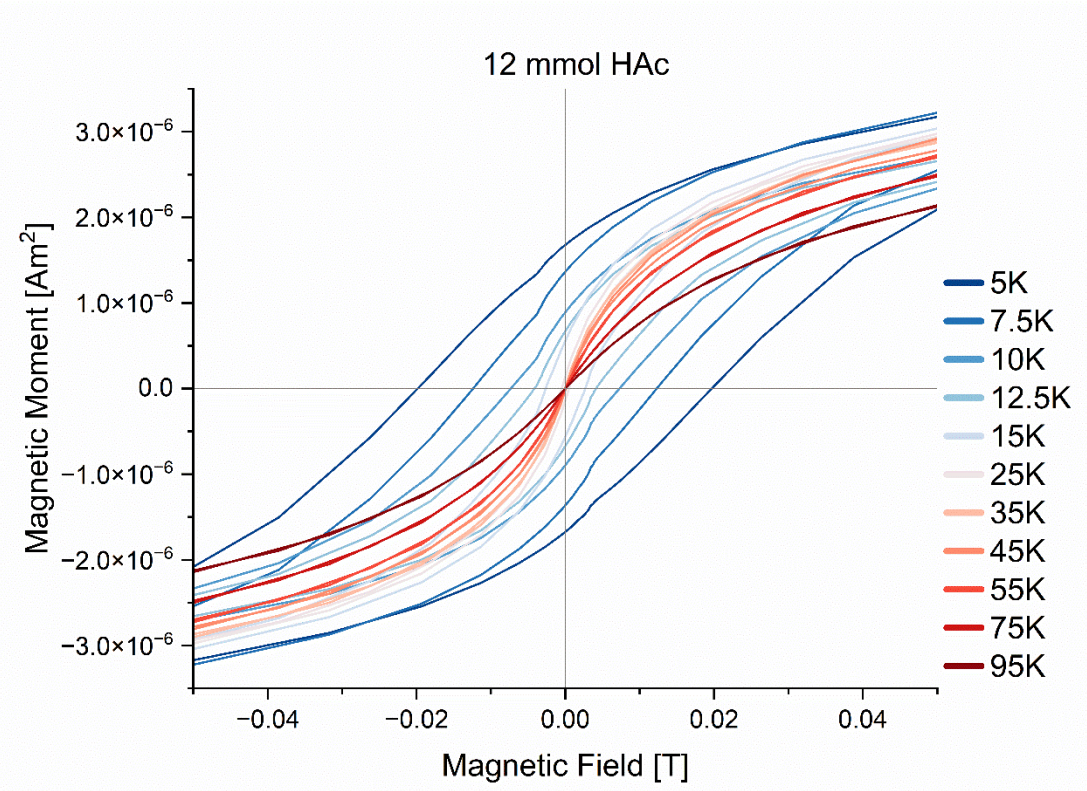

Figure 8: M(H) curves at various temperatures for the 12 mmol HAc thin film sample.

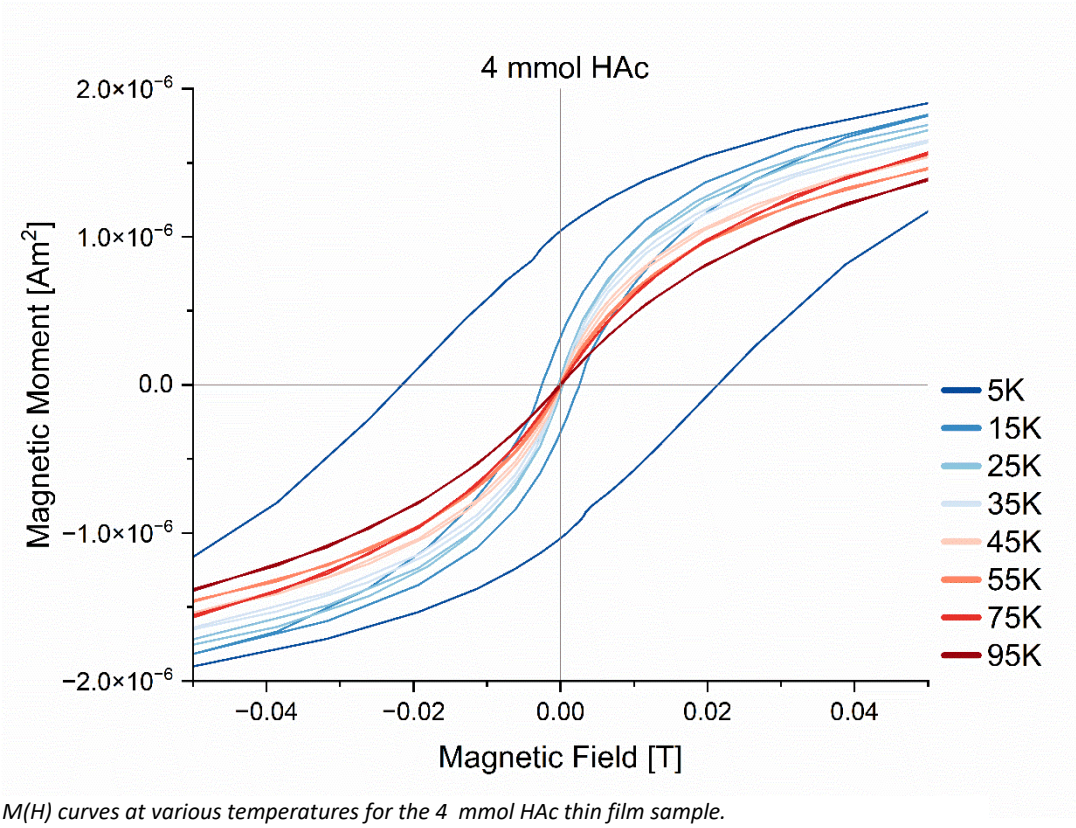

Figure 9: M(H) curves at various temperatures for the 4 mmol HAc thin film sample.

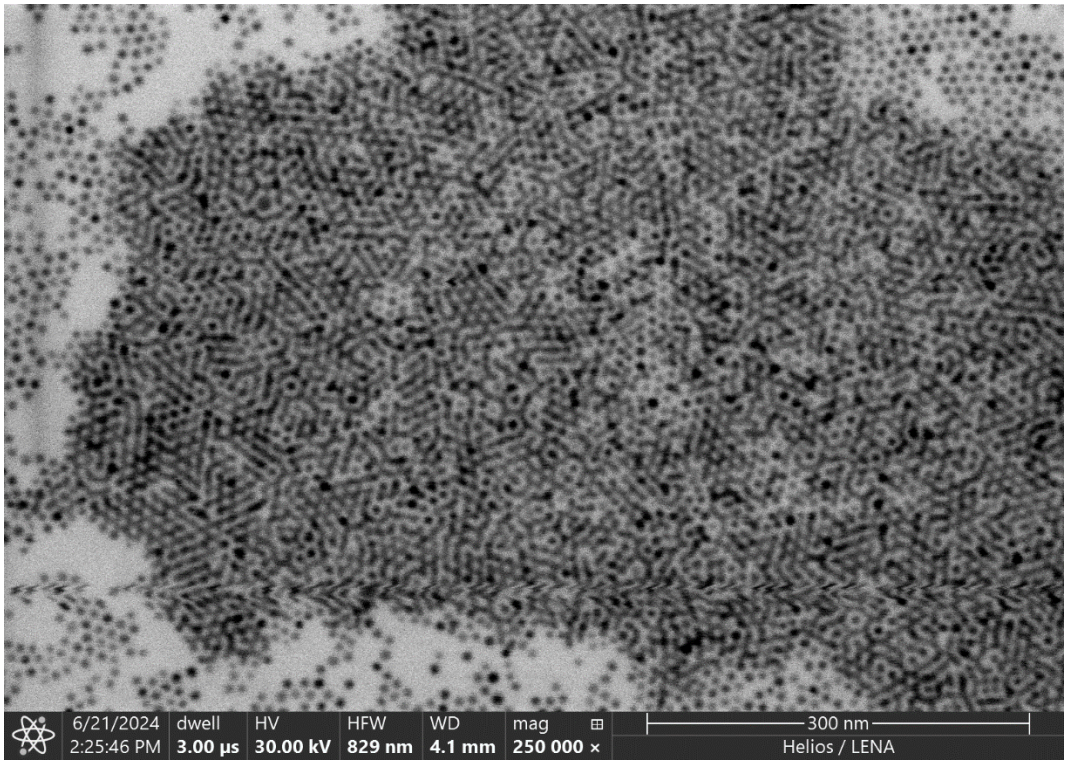

Figure 10: STEM measurement of the 12 mmol SAc sample.

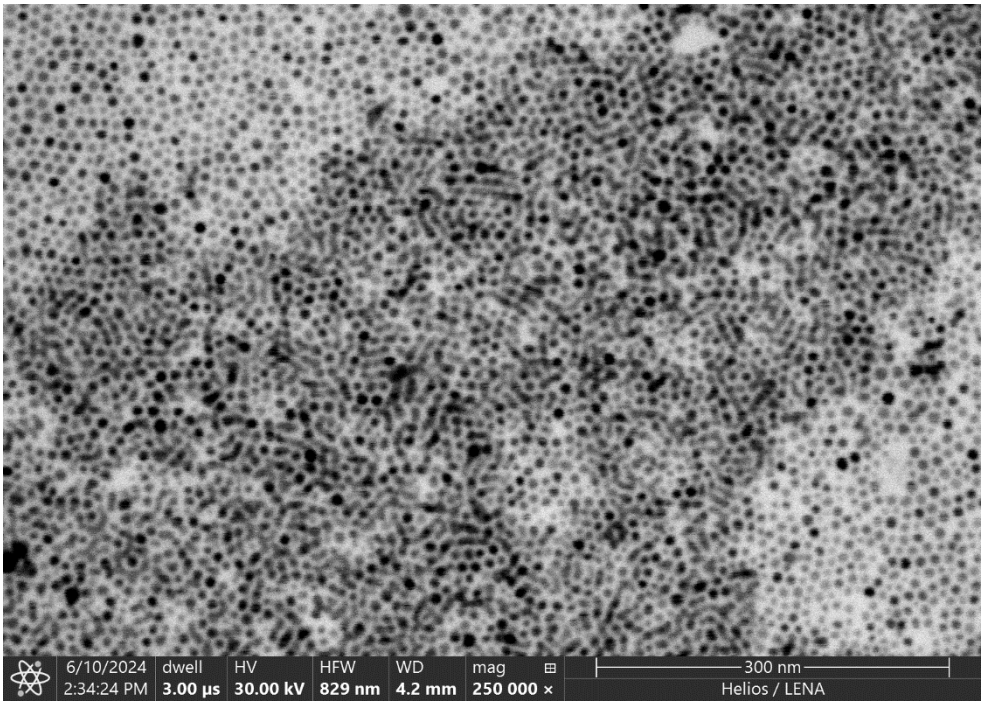

Figure 11: STEM measurement of the 4 mmol SAc sample.

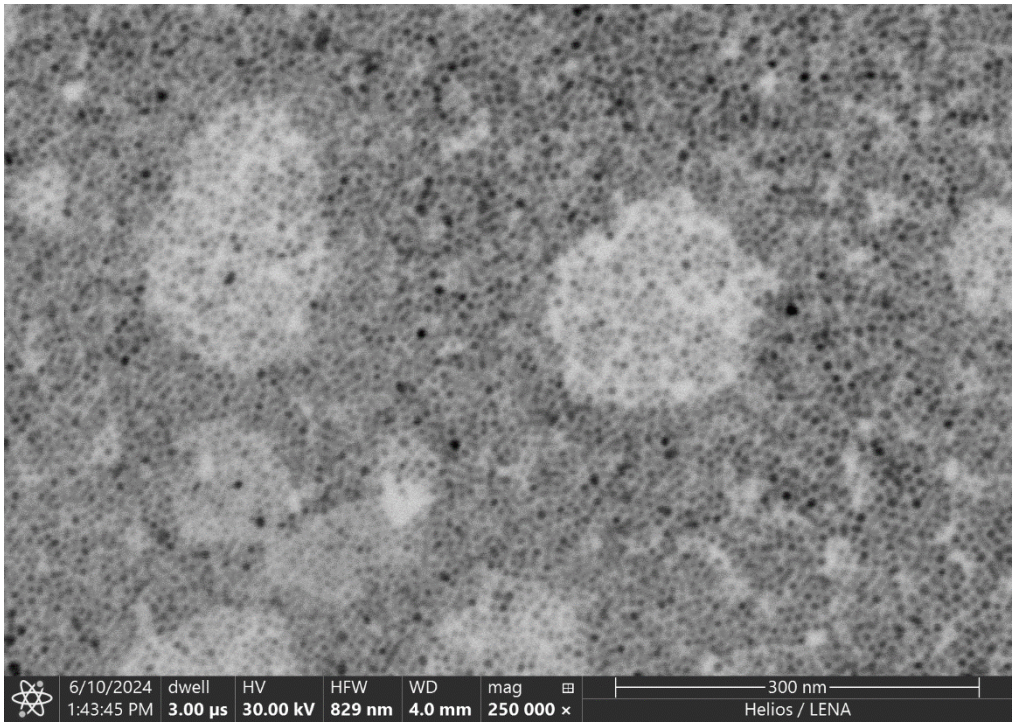

Figure 12: STEM measurement of the 4 mmol DAc sample.

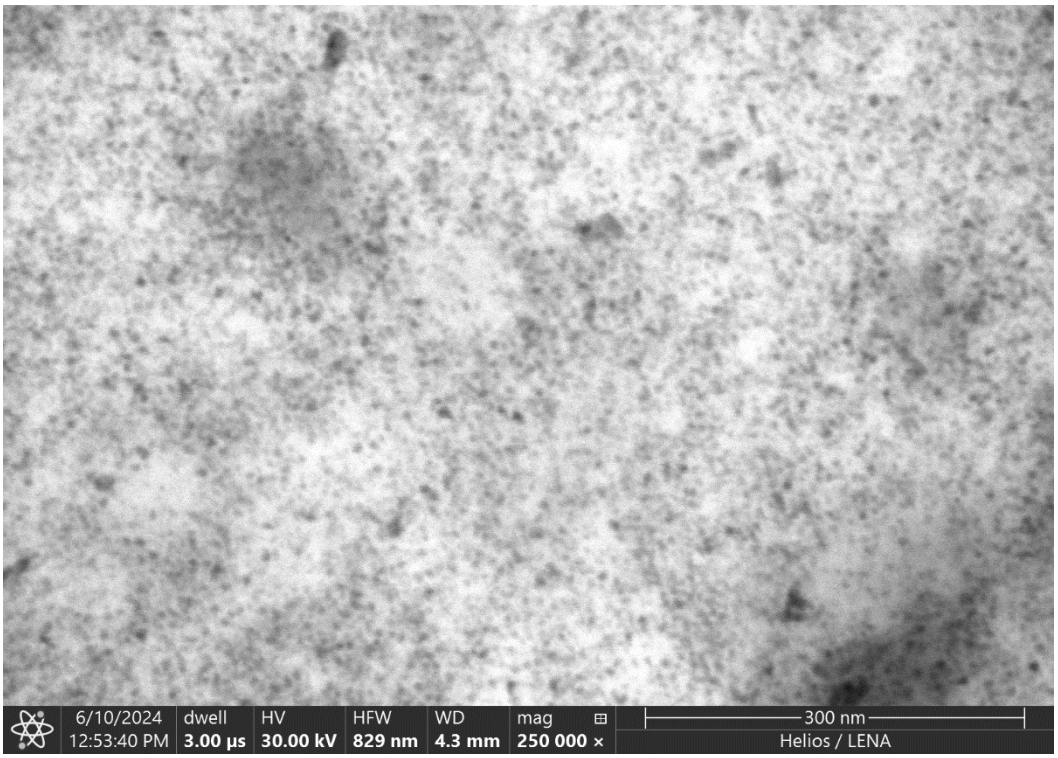

Figure 13: STEM measurement of the 12 mmol HAc sample.