# Supplementary Information

## Electron conductive self-assembled hybrid low-molecular weight glycolipid-nanosilver gels

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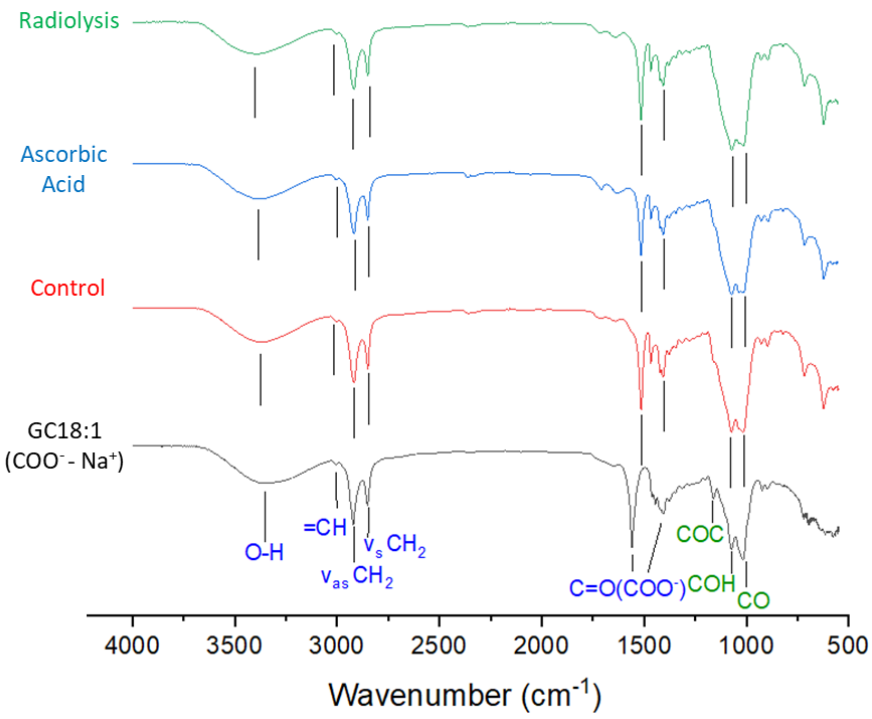


**Figure S 1. Full FTIR spectra on freeze-dried samples.**

Blue annotated peaks belonging to the aliphatic backbone and carboxylate group remained unchanged upon gel formation and reduction. The broad peak observed at 3344 $cm^{-1}$ corresponds to O-H stretch and the small peak at 3005 $cm^{-1}$ corresponds to CH groups of the alkene. The bands at 2921 $cm^{-1}$ and 2852 $cm^{-1}$ are due to asymmetrical stretching ($\nu_{as}$ $CH_2$) and symmetrical stretching ($\nu_s$ $CH_2$) of methylene, respectively[1]. Similarly, the green annotated bands at 1161 $cm^{-1}$, 1075 $cm^{-1}$ and 1015 $cm^{-1}$, corresponding to the ether or alcohol linkages found in the glucose groups, stay intact upon gelification and further reduction as well. This shows that the structure of G-C18:1 doesn't change after reduction.

The spectrum of GC18:1 at pH 8, presents bands at 1560 $cm^{-1}$ and 1406 $cm^{-1}$, corresponding to $COO^-$ asymmetrical and symmetrical stretching, when the carboxylate group is coordinated with $Na^+$ ion. Upon gel formation due to $COO^-$-$Ag^+$ coordination, the band due to $\nu_{as}$ $COO^-$ at 1560 $cm^{-1}$ shifts to 1510 $cm^{-1}$, and the frequency difference between $COO^-$ antisymmetric and symmetric vibrations, $\Delta\nu(=\nu_{as}-\nu_s)$, changes from $\Delta\nu=154$ to $\Delta\nu=104$. This frequency difference can be explained by the change in the coordination type of the carboxylate group from bridging bidentate with $Na^+$ ions, to cheating bidentate with $Ag^+$ ions[2]. Upon reduction by ascorbic acid or radiolysis, these bands stay intact, showing that the coordination of $COO^-$ with $Ag^+$ cations or $Ag^0$ nanoparticles remains identical.

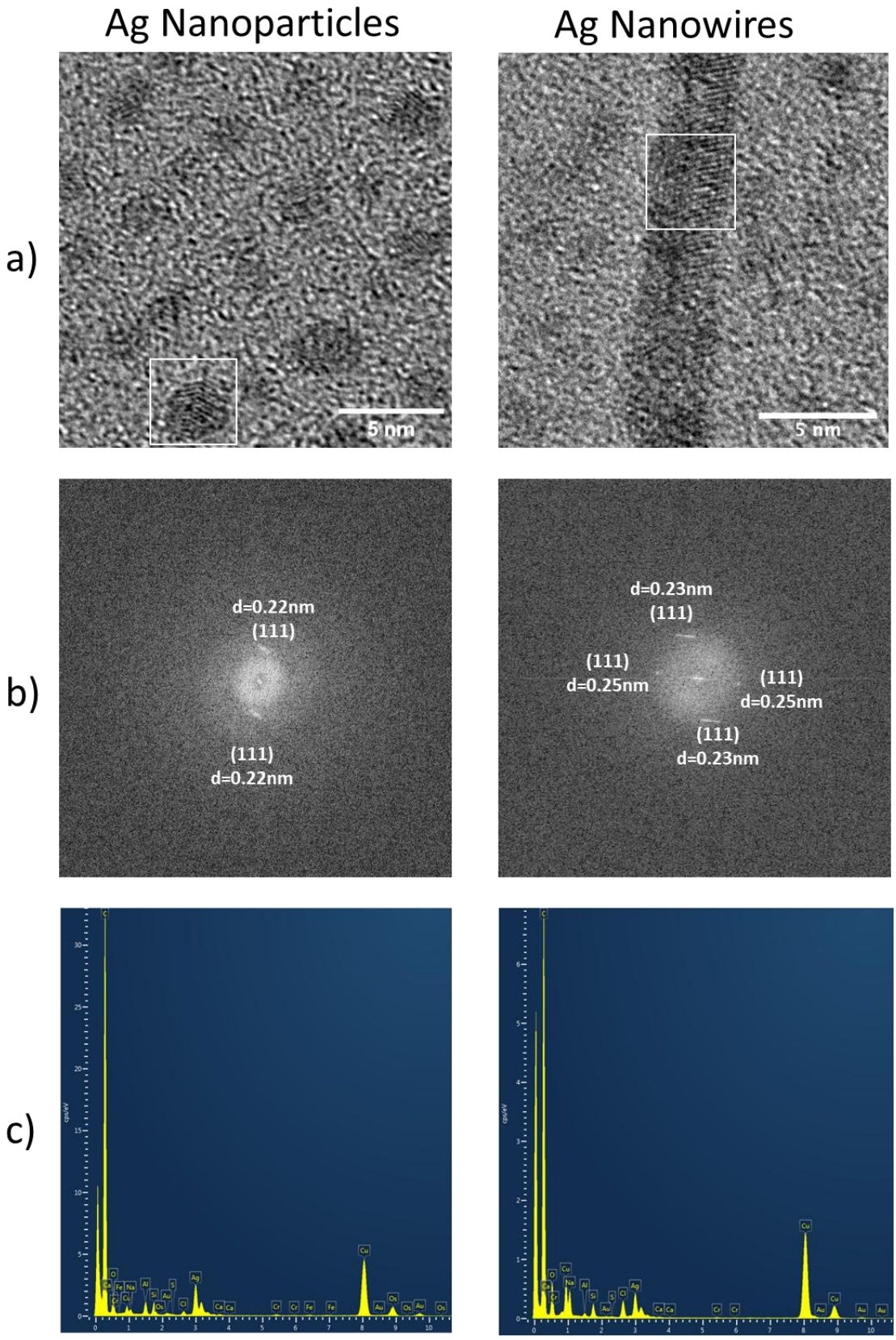


**Figure S 2. a) High Resolution TEM images of nanoparticles and nanowires obtained upon reduction and b) the Fast Fourier Transform (FFT) patterns corresponding to the white squared regions in a). c) Spectra of EDX chemical analysis.**

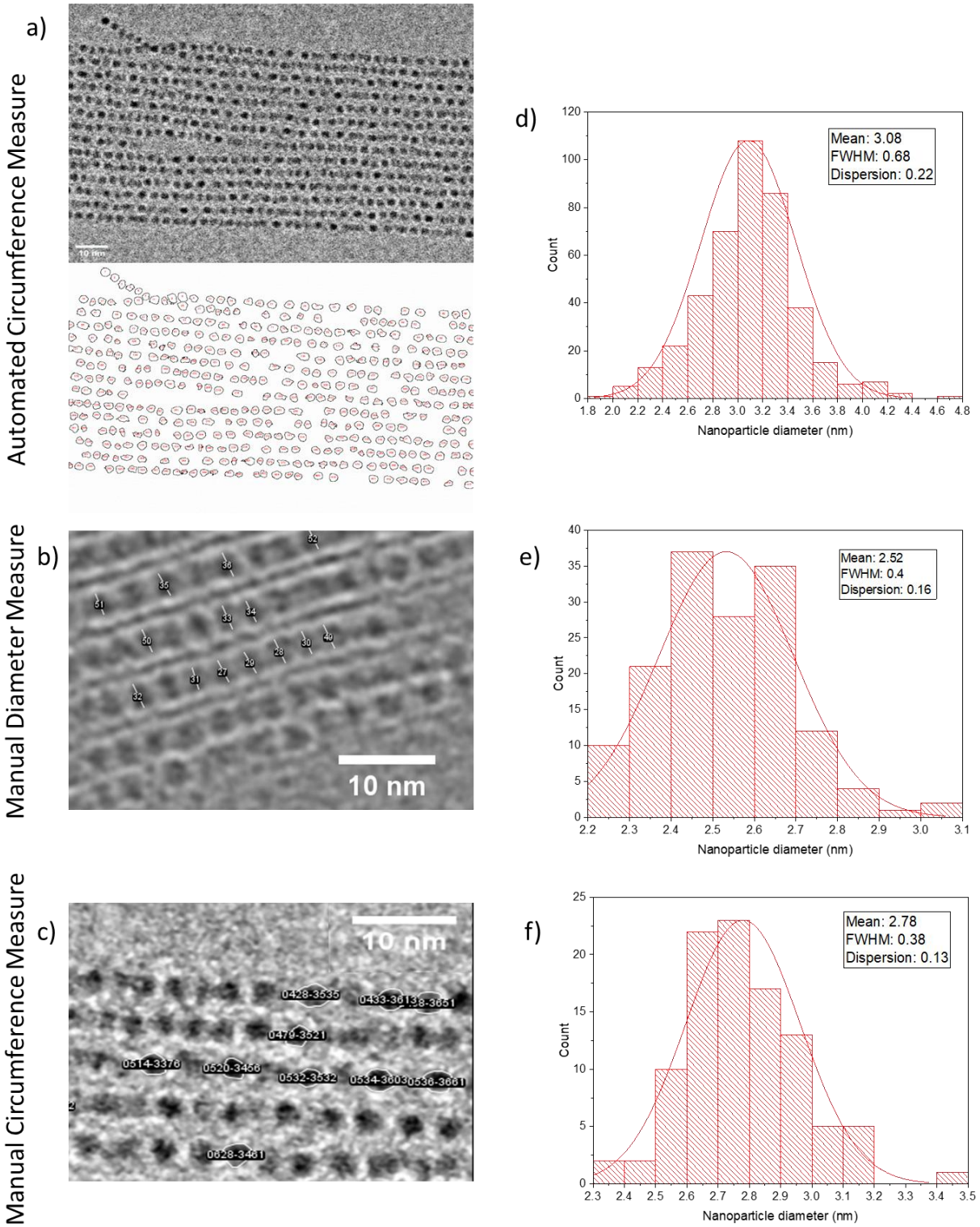


**Figure S 3. Evaluation of the size of Ag nanoparticles visualized by cryo-TEM images. a) Automated method to measure the circumference of the particles by an ImageJ plug-in called "Trainable Weka Segmentation"; b) manual measurement of the diameter of the particles; c) manual measurement of the circumference of the particles and d,e,f) the corresponding size distribution profiles for each method.**

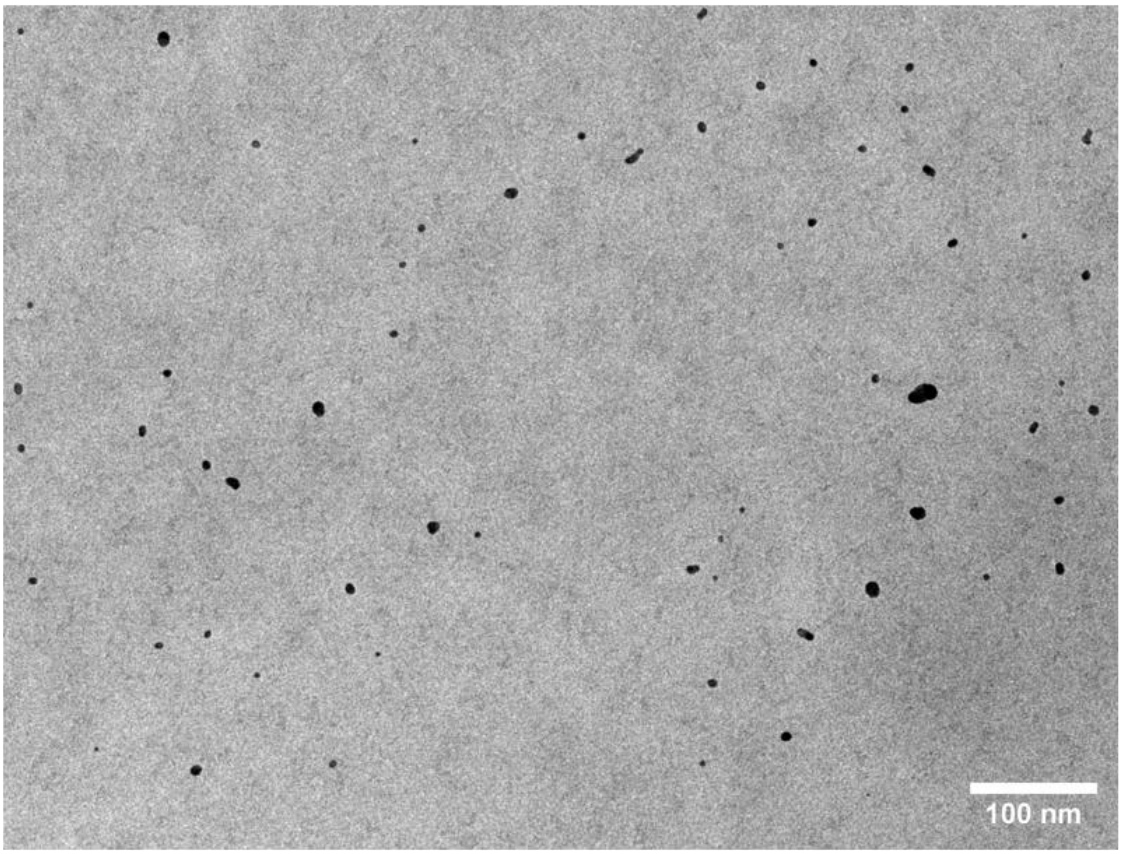


**Figure S 4. Cryo-TEM image of {$Ag^0$}G-C18:1-$NaBH_4$ sample.**

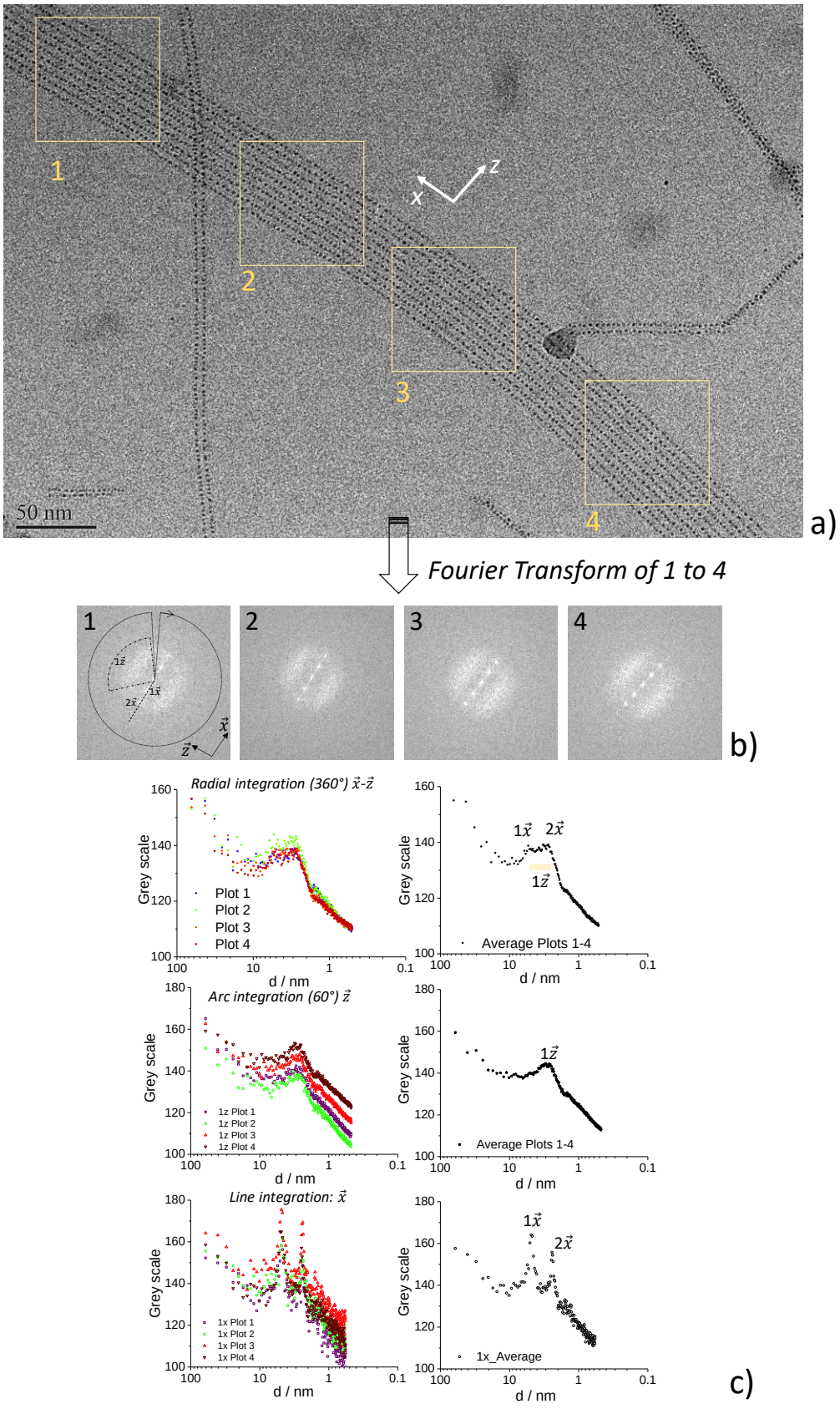


**Figure S 5. a) Typical cryo-TEM image showing the organization of Ag nanoparticles upon reduction; b) FFT patterns of 4 regions selected within yellow squares in a); c) radial (360°), arc (60°) and line integrations done on FFT patterns of the 4 different regions, and their averages where $1\vec{x}$, $2\vec{x}$ and $1\vec{z}$ peaks are labeled.**

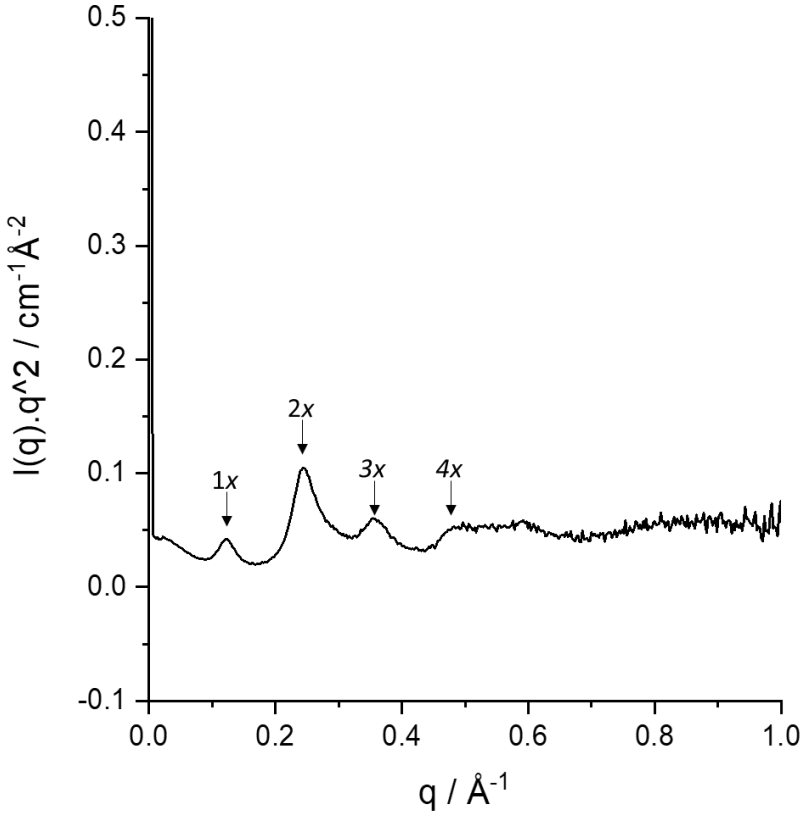


**Figure S 6. Kratky plot of a SAXS measurement done for {$Ag^+$}G-C18:1.**

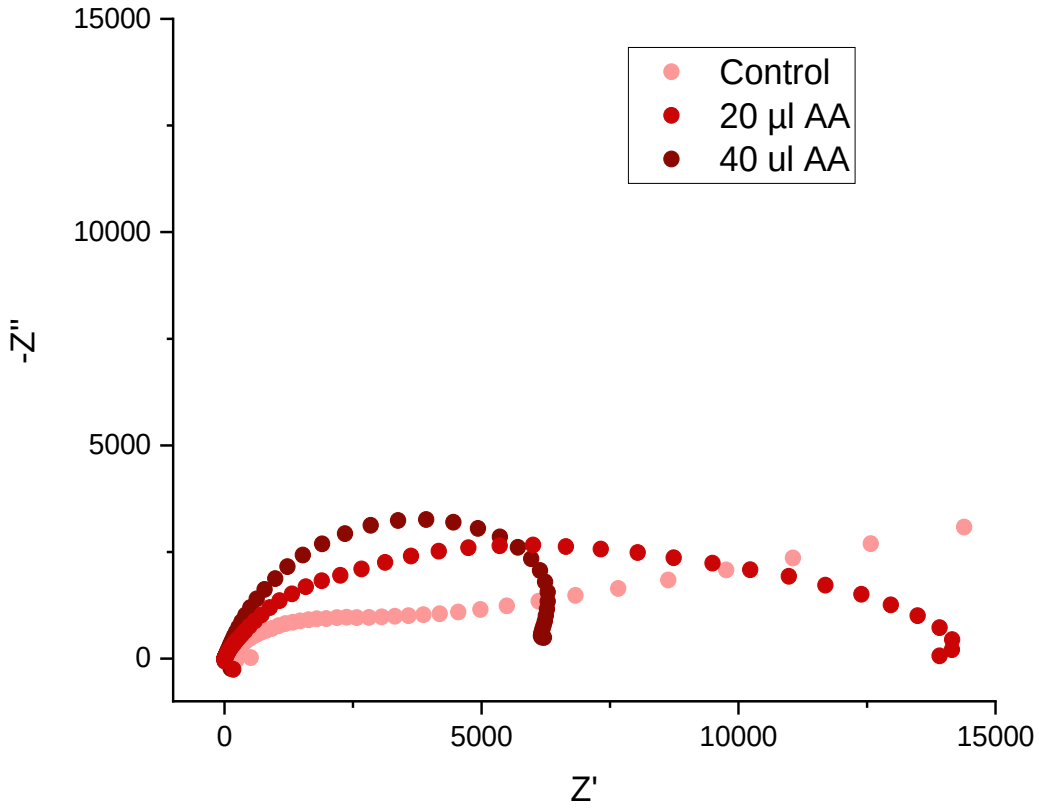


**Figure S 7. Nyquist plots of {$Ag^{+}$}G-C18:1 control and {$Ag^{0}$}G-C18:1 samples prepared with two different content of ascorbic acid (AA)**

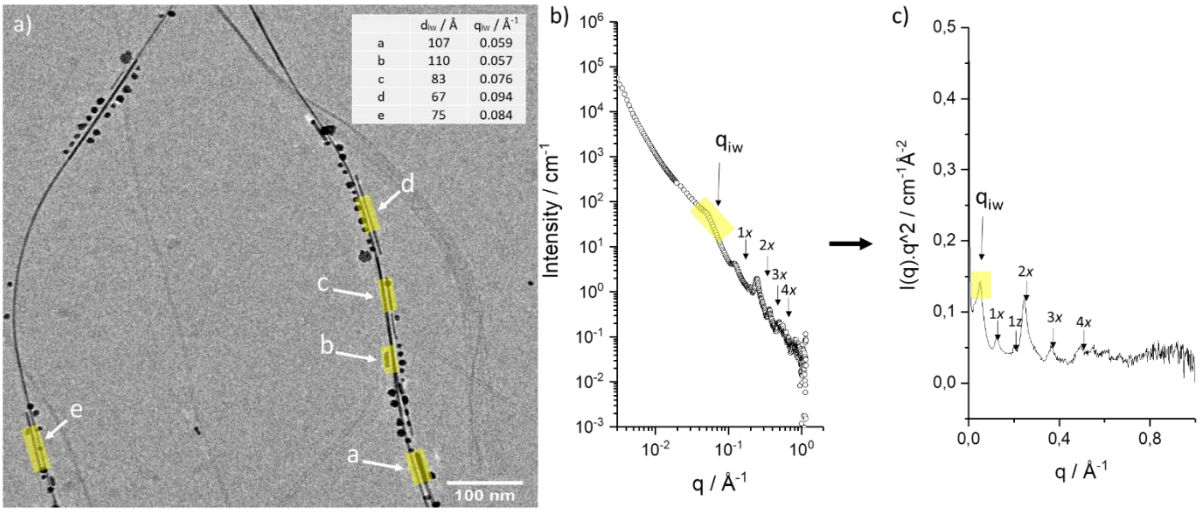


**Figure S 8. a) Cryo-TEM image of silver nanowires formed upon reduction by ascorbic acid. The inter-wire distance ($d_{iw}$) is calculated manually from the yellow areas and noted in the table, with the corresponding q values. b) SAXS measurement for the same sample, with c) the corresponding Kratky plot. The peak highlighted with yellow has a q value ($q_{iw}$) coherent with the measured interwire values.**

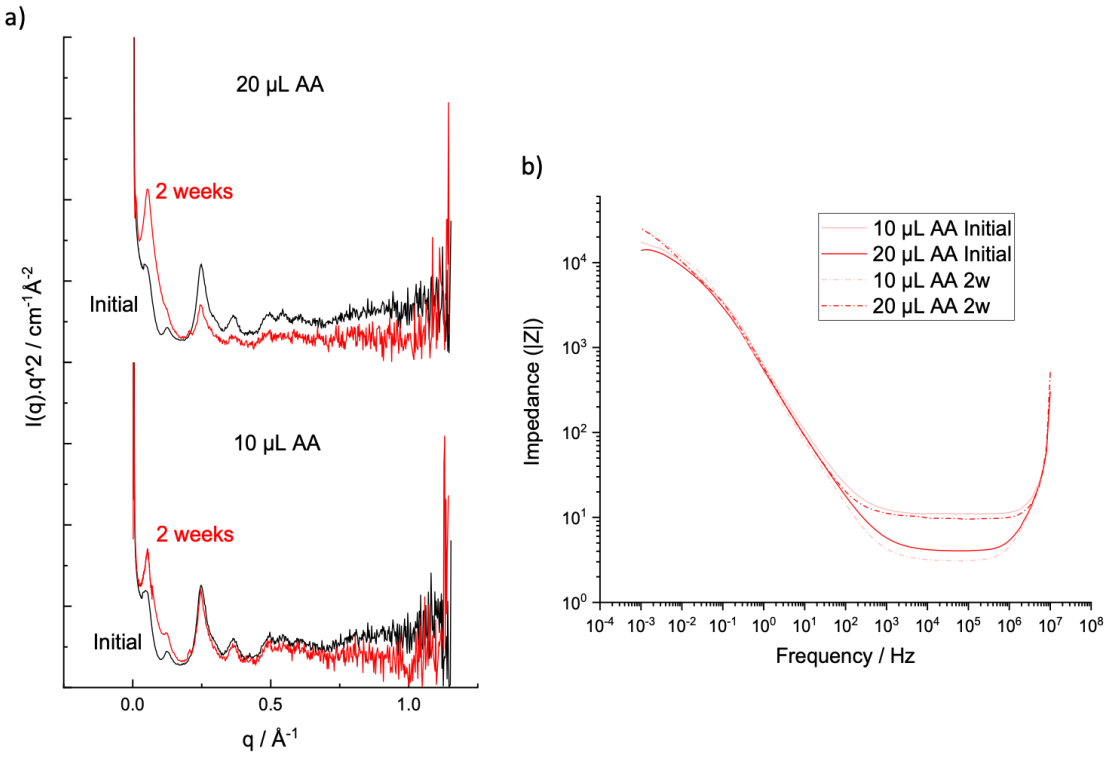


**Figure S 9. a) Kratky plots of the SAXS measurements and b) impedance spectroscopy measurements for {Ag$^0$}G-C18:1-AA gels (AA content of 10 and 20 µL/mL) performed initially and after 2 weeks.**

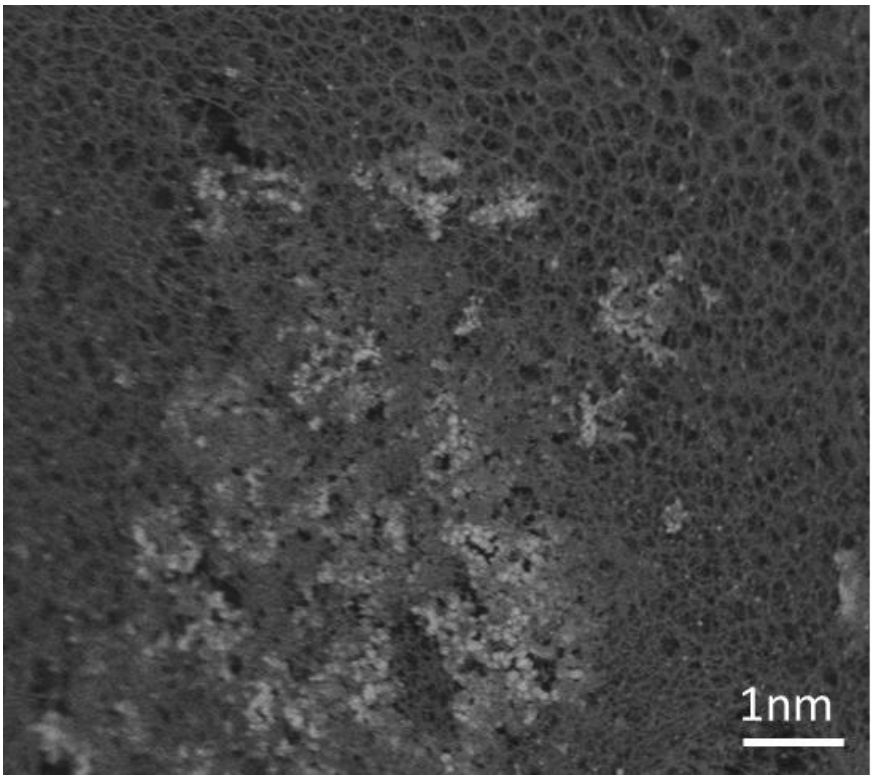


**Figure S 10. Cryo-SEM image of a {$Ag^0$}G-C18:1-AA gel (AA content of 40 µL/mL) where coexistence of the 3D fiber network and nanoparticles can be observed.**

## References

1. Bajaj, V. K. & Annapure, U. S. Castor Oil as Secondary Carbon Source for Production of Sophorolipids Using Starmerella Bombicola NRRLY-17069. *J Oleo Sci* **64**, 315–323 (2015).
2. Uznanski, P., Zakrzewska, J., Favier, F., Kazmierski, S. & Bryszewska, E. Synthesis and characterization of silver nanoparticles from (bis)alkylamine silver carboxylate precursors. doi:10.1007/s11051-017-3827-5.