SUPPORTING INFORMATION

Core-shell polymeric micelles based on the 2-(hydroxyimino)aldehyde group as self-contained nanoreactors to obtain single and clustered ultra-small silver nanoparticles.

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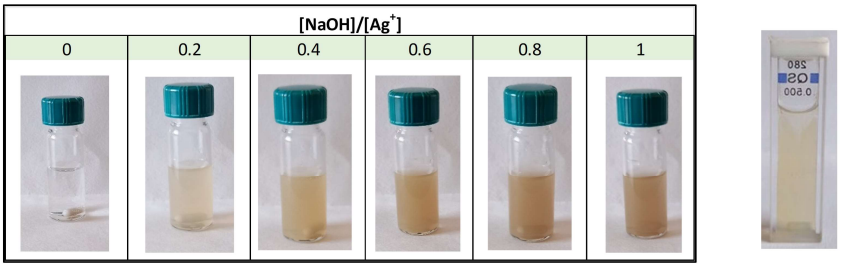

Figure S1. Solutions of 1.8 mM $AgNO_3$ 2 minutes after addition of NaOH for different [NaOH] / [Ag^+] ratios (vials on the left). Solution of 1.8 mM $AgNO_3$ and G4 2 minutes after addition of NaOH ([NaOH] / [Ag^+] = 1) (0.5 cm UV cuvette on the right).

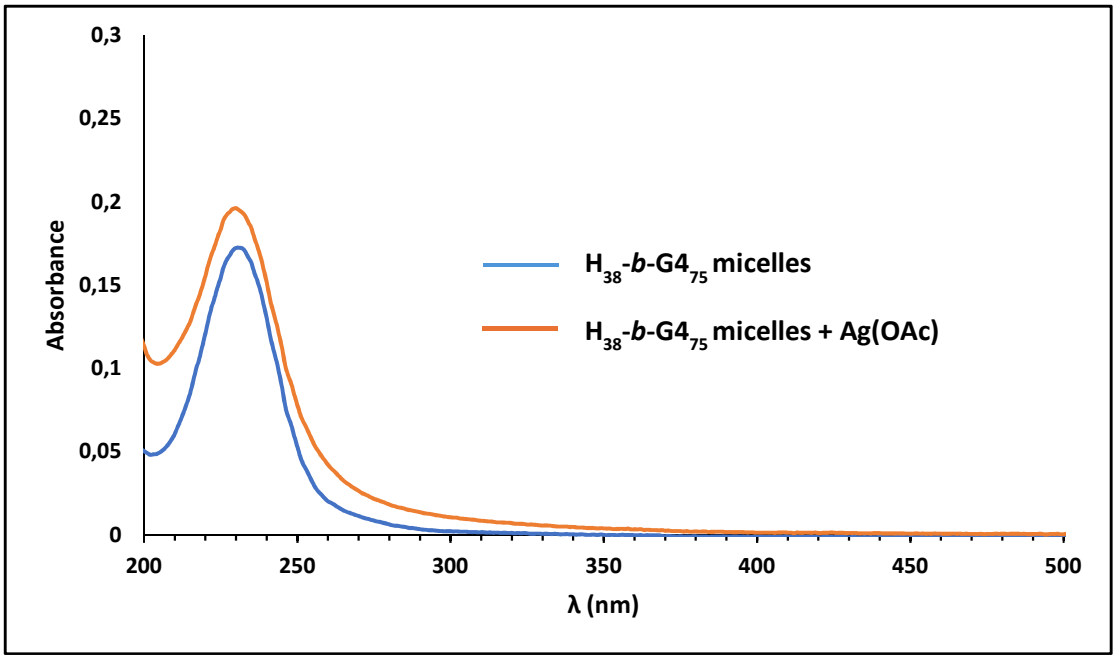

Figure S2. UV-Vis spectra of **H_{38}-*b*-G4$_{75}$** micelles before and after addition of AgOAc 40 mM ([HIA] = 1.8 x 10^{-3} M; [Ag^+] /[HIA] = 1:1). Optical path length 0.1 mm.

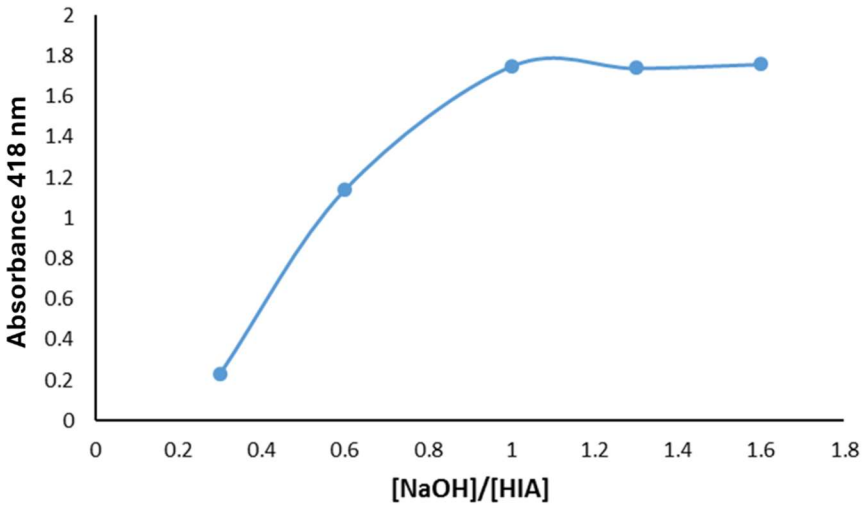

Figure S3. Absorbance at 418 nm of the SPR band of AgNP in water for **H_{38}-*b*-$G4_{75}$** ([HIA] = 1.8 x 10^{-3} M, [HIA] / [Ag^{+}] = 1:1). Optical path length 0.5 cm.

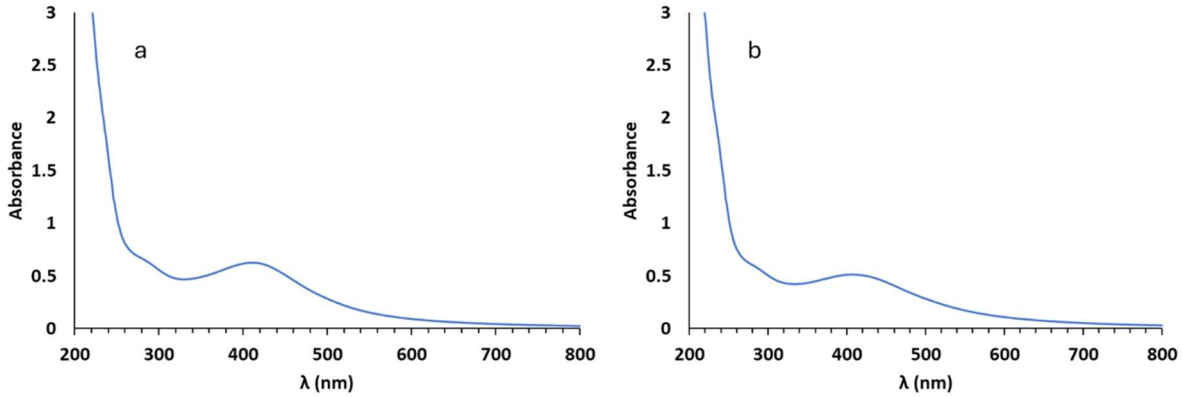

Figure S4. Absorption spectra in water of **H_{73}-*b*-$G4_{75}$** (a) and **H_{37}-*r*-$G9_{37}$** (b) micelles ([HIA] = 1.8 x 10^{-3} M) after 24 hours addition of $AgNO_3$ and NaOH ([HIA] / [Ag^{+}] / [NaOH]=1:1:1). Optical path length 0.1 mm.

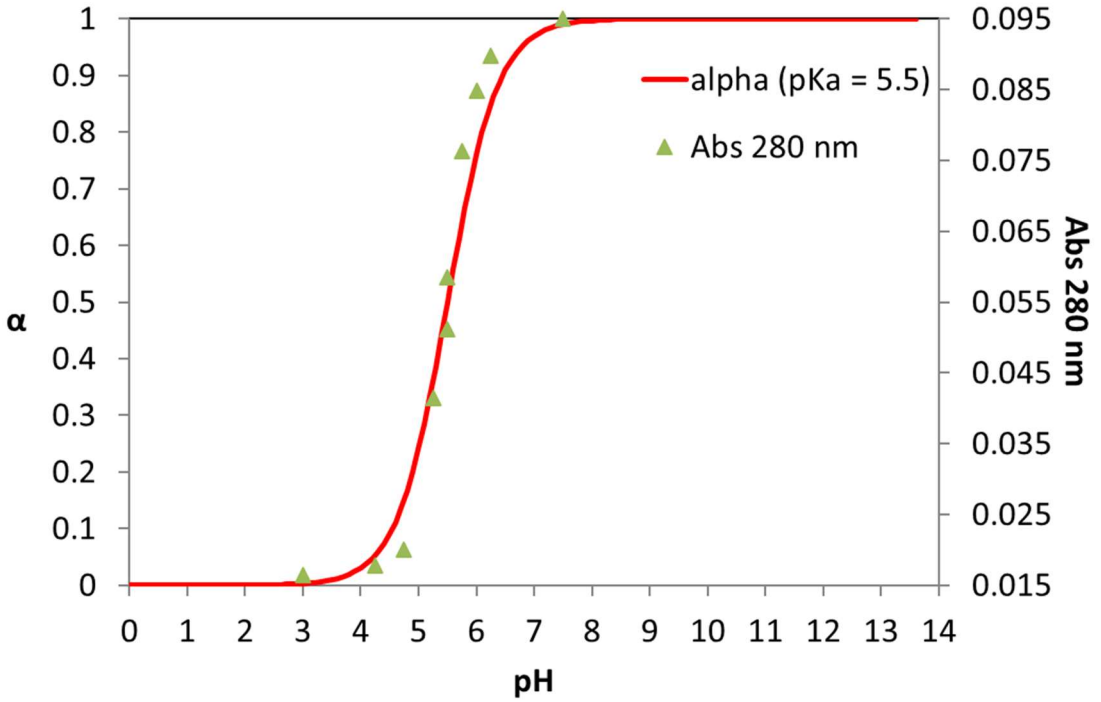

Figure S5. Absorbance at 280 nm of **H_{38}-*b*-$G4_{75}$** micelles with $AgNO_3$ ([HIA] = 1.8 mM, [HIA] / [Ag^+]=1:1) as a function of pH. NaOH 0.1 M added to increase pH. Optical path length 0.01 mm. Red line: Theoretical curve of the degree of dissociation (α) of an acid with pKa = 5.5.

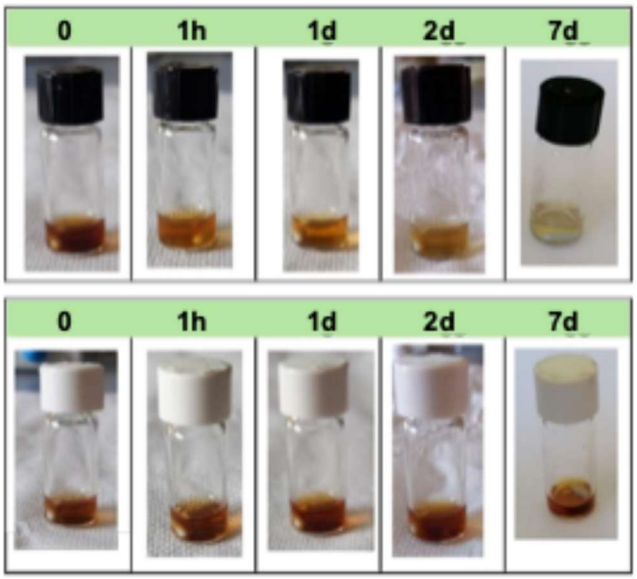

Figure S6. Pictures of silver/**H_{38}-*b*-$G4_{75}$** micelles/NaOH mixtures at different times (up to 7 days) after addition of HNO_3 (top) and NH_3 (bottom). ([HIA] = 1.8 x 10^{-3} M, [HIA] / [Ag^+] /[OH^-] = 1:1:1).

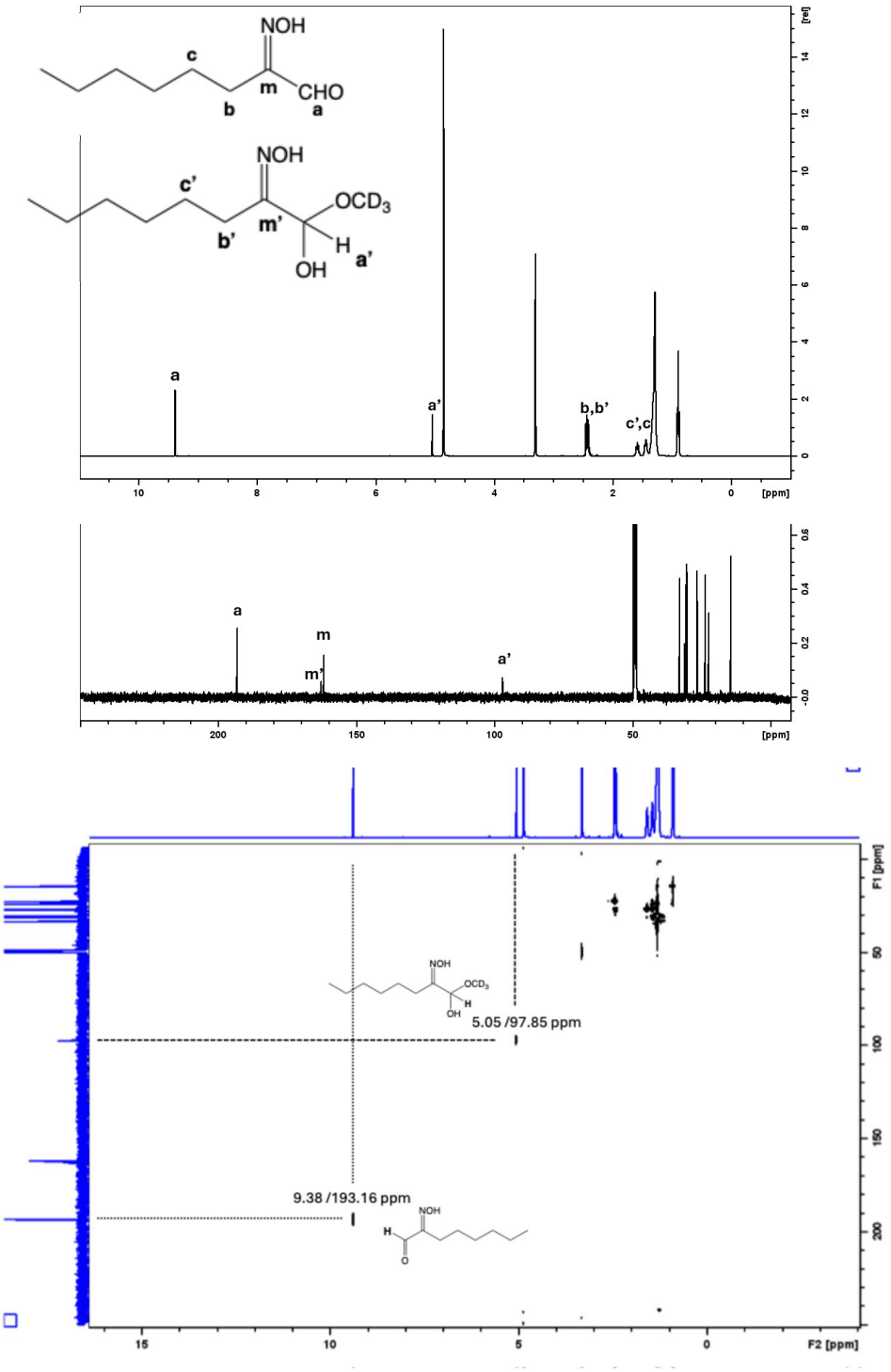

Figure S7. ^{1}H, ^{13}C and HSQC NMR spectra of 2-(hydroxyimino)decanal after addition of $AgNO_3$ ([HIA] / [Ag^+] = 1:2) in CD_3OD (δ relative to solvent peak). The resulting solution is a mixture of the aldehyde and its hemiacetal form. $^{1}H/^{13}C$ NMR: -<u>*CH*</u>O 9.38/193.16 ppm; -<u>*CH*</u>(OCD_3)OH) 5.05/97.85 ppm; -<u>*CH*$_2$</u>-C(NOH)- 2.46-2.41/ 22.28 (aldehyde) and 26.23 (hemiacetal)

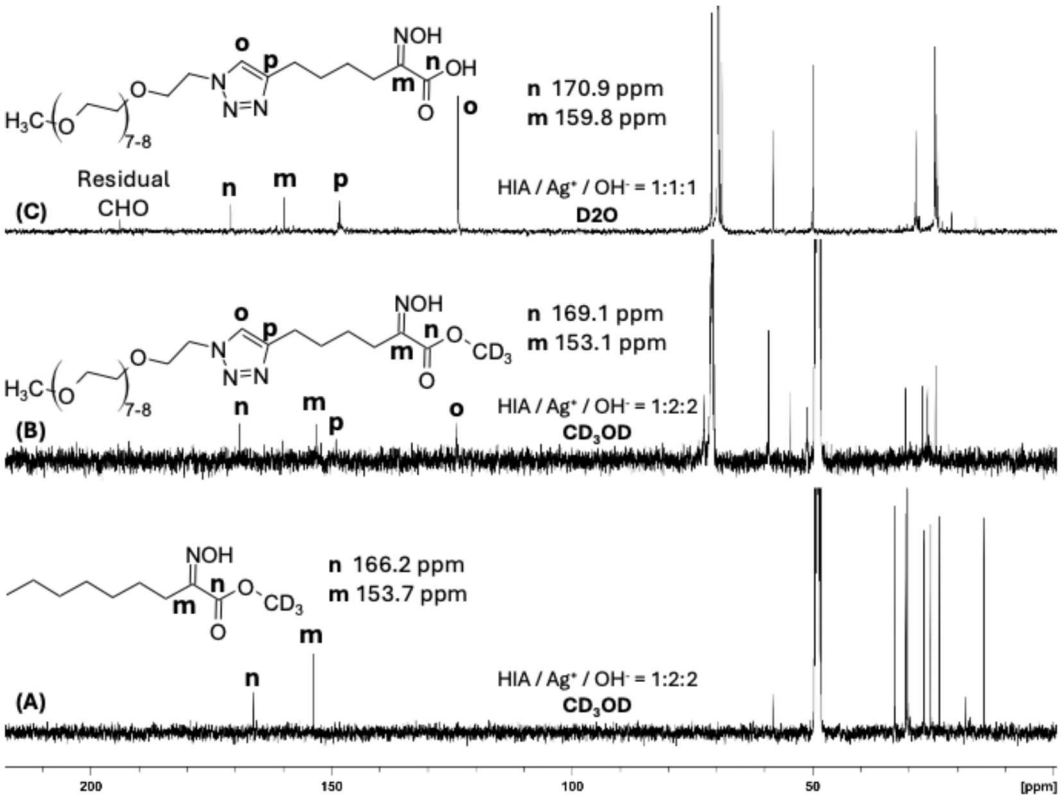

Figure S8. ^{13}C NMR spectra of the carboxylates resulting from the oxidation of 2-(hydroxyimino)decanal (**A**) in CD_3OD, and 6-(1-heptyl-1,2,3-triazol-4-yl)-2-(hydroxyimino)hexanal (see F. D'Acunzo et al. *Eur. J. Org. Chem.* **2021**, *2021*, 289) in CD_3OD (**B**) and in D_2O (**C**) with Ag^+ / OH^-. See **Scheme 4** in the main text.

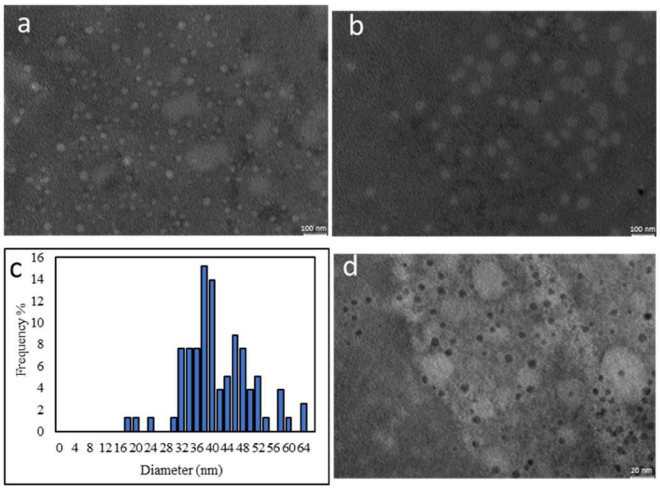

Figure S9. a), b) TEM images of nanoparticles formed by pH induced nanoaggregation of **H37-*r*-G937** random copolymer (negative staining with PTA). c) Size distribution of the **H37-*r*-G937** nanoparticles obtained by TEM images analysis. d) TEM image of the AgNPs ([HIA]:[Ag^+]:[NaOH]=1:1:1, [HIA] = 1.8 mM) formed in presence of **H37-*r*-G937** (negative staining with PTA).

Table S1. Details of the models and parameters used for obtaining the calculated SAXS profiles shown in Figure 8c.

a) Sample	**H_{38}-*b*-$G4_{75}$** 1.5 mg mL^{-1} pH 7.3 (pH-induced micelles)	
Model	Block copolymer micelle (SASfit 0.94.12 documentation, model 3.2.4.4)	
q range (nm^{-1})	0.045-7.5	
reduced χ^2	2.39	
Parameters		
N_{agg} (aggregation number)	48	Fixed
$V_{block\ core}$ (nm^3)	11	Fixed
$V_{block\ shell}$ (nm^3)	29.5	Fixed
SLD_{core} (nm^{-2})	$11 \cdot 10^{-4}$	Fixed
SLD_{shell} (nm^{-2})	$11 \cdot 10^{-4}$	Fixed
$SLD_{solvent}$ (nm^{-2})	$9.40 \cdot 10^{-4}$	Fixed
d (penetration parameter)	1	Fixed
R_g (nm)	3.42 ± 0.03	Optimized
N (number density, $10^{-7} nm^{-3}$)	5.87± 0.02	Optimized
Background (cm^{-1})	0.00038± 0.00001	Optimized
R_{core} (nm)	5.0	Calculated $R_{core} = \sqrt[3]{\frac{3N_{agg}V_{core}}{4\pi}}$
σ (surface coverage index)	1.97	Calculated $\sigma = \frac{\pi R_g^2 N_{agg}}{4\pi(R_{core}+R_g)^2}$

b) Sample	**H_{38}-*b*-$G4_{75}$** 1.5 mg mL^{-1} + NaOH + $AgNO_3$ ([H_{38}-*b*-$G4_{75}$]:[NaOH] :[$AgNO_3$] = 1:1:1, [HIA] = 1.8 mM) (AgNPs-**H_{38}-*b*-$G4_{75}$**)
Model	Sphere form factor (SASfit 0.94.12 documentation, model 3.1.1) and Cluster structure factor with local hard-sphere interactions (model 11.7.7)
q range (nm^{-1})	0.045-6.3
reduced χ^2	7.8
Parameters	

Background (cm^{-1})	0.0004	Fixed
Form factor		
N (number density, $10^{-7}nm^{-3}$)	103.89± 0.07	Optimized for q> 1.5 nm^{-1}
<r> (nm)	0.785± 0.012	Optimized for q> 1.5 nm^{-1}
$SLD-SLD_{solvent}$ (nm^{-2})	$48 \cdot 10^{-4}$	Fixed
Structure factor		
R radius of particles in cluster (nm)	1.127± 0.004	Optimized
φ local volume fraction inside cluster	0.097± 0.12	Optimized-poorly determined
ξ size (correlation length) of cluster (nm)	4.703±0.002	Optimized
ε shape parameter of cluster (<1:disc; >1:rod)	1	Fixed (Globular, spherical)

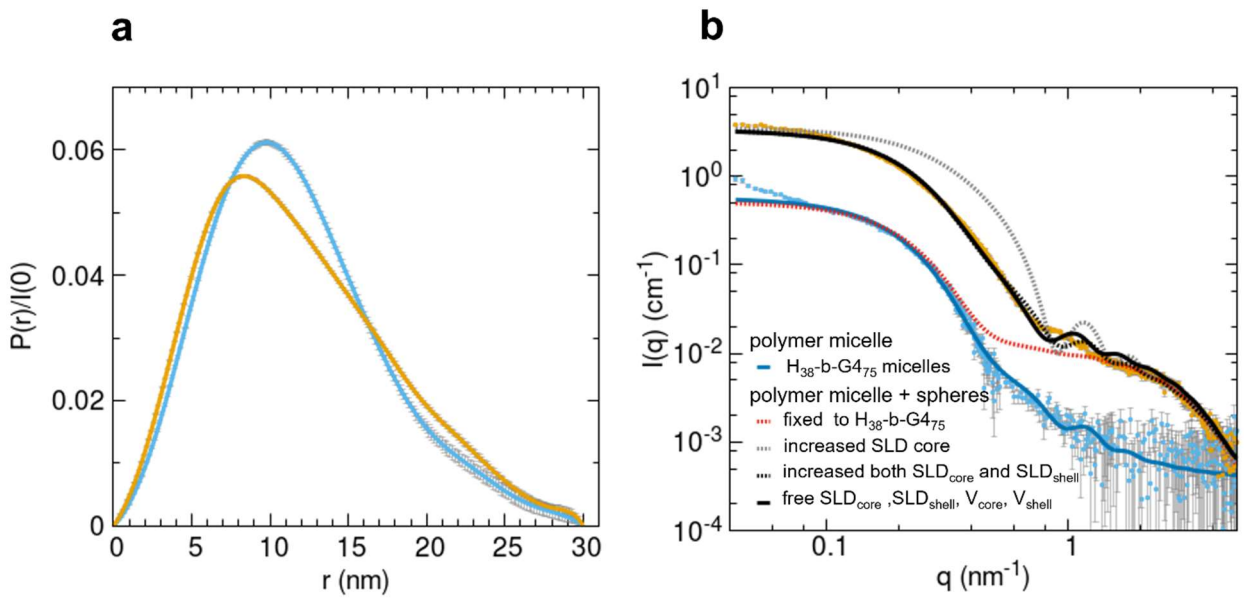

Figure S10. a) Pair distance distribution functions P(r) obtained by indirect Fourier transform of the SAXS data of the **H_{38}-*b*-$G4_{75}$** micelles before (cyan line) and after formation of the AgNPs (orange line), normalized by the value of the intensity extrapolated at zero angle (I(0), i.e. the subtended area) for better comparison of the maximum position. b) Attempt of modelling the SAXS data of AgNPs-**H_{38}-*b*-$G4_{75}$** by a simple sum of the scattering from small spherical particles (to account for the SAXS signal at q > 1.5 nm^{-1}) and of polymer micelles. Starting from considering the same model as before Ag+ addition (red dotted line), the effect of increasing the average scattering length density of only the core (grey dotted line) or of both core and shell (black dotted and solid lines) in the SAXS model of block copolymer micelles is evaluated to account for Ag incorporation.

Equation S1. Limit for $q \to 0$ of a "Dirty snowball form factor",[66] comprising a large embedding sphere (scattering length density difference compared to the solvent ΔSLD_L in nm^{-2}, volume V_L in nm^3) with internal small domains or particles having different density (scattering length density difference compared to the embedding sphere ΔSLD_{S-L}, volume V_S):

$$P(0) = \Delta SLD_L{}^2 V_L{}^2 P_L(0) + n\Delta SLD_{S-L}{}^2 V_S{}^2 P_S(0) + 2\Delta SLD_L \Delta SLD_{S-L} V_L V_S A_L(0) A_S(0) \lim_{q\to 0} \sum_i \frac{\sin qr_{center,i}}{qr_{center,i}} + \Delta SLD_{S-L}{}^2 V_S{}^2 P_S(0) \lim_{q\to 0} \sum_{i,j} \frac{\sin qr_{i,j}}{qr_{i,j}}$$

$P_L(0)$ and $A_L(0)$ are the $q \to 0$ limiting values of the large sphere form factor and scattering amplitude, $P_S(0)$ and $A_S(0)$ are the $q \to 0$ limiting values of the form factor and scattering amplitude for the small internal particles, n is the number of small spheres contained in the embedding large sphere, and the single and double sums with indexes i and i,j run on the n particles inside the same large sphere.

If the amplitudes and form factors are correctly normalized so that for q → 0, $A_L(0) = A_S(0) = 1$, the macroscopic scattering cross section at q → 0 observed for the sample containing N_L large particles per unit volume becomes:

$$I_0(\mathrm{cm}^{-1}) = 10^7 \left(\frac{\mathrm{nm}}{\mathrm{cm}}\right) \cdot N_L \left[\Delta SLD_L{}^2 V_L{}^2 + n\Delta SLD_{S-L}{}^2 V_S{}^2 + 2n\Delta SLD_L \Delta SLD_{S-L} V_L V_S + n(n-1)\Delta SLD_{S-L}{}^2 V_S{}^2\right]$$

In addition, due to the notable size difference between the large spherical particles and the small embedded AgNPs, it is reasonable to assume that the scattering signal for q >1.5 nm^{-1}, is given by the AgNPs only:

$$I_{small}(\mathrm{cm}^{-1}) = 10^7 \left(\frac{\mathrm{nm}}{\mathrm{cm}}\right) N_L n \Delta SLD_{S-L}{}^2 V_S{}^2 P_S(q)$$

So, after expressing the volumes V_L and V_S in terms of the large and small spherical radii (R_L and R_S), the ratio between the $q \to 0$ SAXS intensity values for the "dirty snowball" nanoparticle clusters and the individual nanoparticles is expected to be:

$$\frac{I_0}{I_{small}(0)} = \left(\frac{\Delta SLD_L}{\Delta SLD_{S-L}}\right)^2 \left(\frac{R_L}{R_S}\right)^6 \frac{1}{n} + 2\frac{\Delta SLD_L}{\Delta SLD_{S-L}} \left(\frac{R_L}{R_S}\right)^3 + n$$

This equation can be solved to find the value of n which is in agreement with the experimental value of the ratio $\frac{I_0}{I_{small}(0)}$ and the assumed values for ΔSLD_L, ΔSLD_{S-L}, R_L and R_S, as reported in Table S2

By redefining the factor $\frac{\Delta SLD_L}{\Delta SLD_{S-L}} \left(\frac{R_L}{R_S}\right)^3 = F$, and the experimental $\frac{I_0}{I_{small}(0)} = R$ from SAXS data, the equation to be solved becomes:

$$n^2 + (2F - R)n + F^2 = 0$$

Having as solutions $n = \frac{R-2F \pm \sqrt{R^2-4FR}}{2}$, with uncertainty (only considering a standard deviation of R)

$$\sigma_n = \sqrt{\left(\frac{1 \pm \frac{R-2F}{\sqrt{R^2-4FR}}}{2}\right)^2 \cdot \sigma_R^2}.$$

Table S2: Estimates of the number of AgNPs per block copolymer micelle in the sample AgNPs-**H_{38}-*b*-$G4_{75}$** ([HIA]:[NaOH]:[Ag^+] 1:1:1 [HIA]=1.8 mM) from both stoichiometric calculations and assuming the limit for q→0 of the "dirty snowball" model (Eq. 1).

	Bulk Ag density	***AgNPs density***
a) ***Stoichiometric calculations***		
[HIA] (M)	$1.8 \cdot 10^{-3}$	
Number density of H_{38}-*b*-$G4_{75}$ micelles (nm^{-3}) $N_{micelles} = \frac{10^{-3}(\frac{dm^3}{nm^3}) \cdot [\text{HIA}] \cdot N_{Avogadro}}{N_{agg} \cdot 38}$ $(N_{agg} = 48)$	$5.94 \cdot 10^{-7}$	
[Ag^+] (M)	$1.8 \cdot 10^{-3}$	
Mass concentration of Ag in sample ($g \cdot cm^{-3}$) $c = 10^{-3}(\frac{dm^3}{cm^3}) \cdot [Ag^+](\frac{mol}{dm^3}) \cdot 106.8682\ (\frac{g}{mol})$	0.000192	
Radius of AgNPs, R_S (nm) (from fit of SAXS data at q> 1.5 nm^{-1})	0.785	
AgNPs density d ($g \cdot cm^{-3}$)	10.5	7.9
Volume fraction of Ag in sample $\Phi_{Ag} = \frac{c}{d}$	$1.83 \cdot 10^{-5}$	$2.43 \cdot 10^{-5}$
Number density of AgNPs in sample (nm^{-3}) $N_{AgNPs} = \frac{\Phi_{Ag}}{\frac{4\pi {R_S}^3}{3}}$	$9.04 \cdot 10^{-6}$	$1.20 \cdot 10^{-5}$
Number of AgNPs per block-copolymer micelle $n = \frac{N_{AgNPs}}{N_{micelles}}$	15.2	**20.2**
b) ***Equation 1*** ($\lim_{q \to 0} \frac{I_0}{I_{small}(0)}$)		
I_0 (cm^{-1})	3.58	
I_0 standard deviation (cm^{-1})	0.02	
$I_{small}(0)$ (cm^{-1})	0.0106	
$I_{small}(0)$ standard deviation (cm^{-1})	0.0002	
$\frac{I_0}{I_{small}(0)}$ (R)	336.8	
$\frac{I_0}{I_{small}(0)}$ standard deviation	6.3	

$SLD_{solvent}$ (nm^{-2}) (water)	$9.4 \cdot 10^{-4}$	
SLD_L (nm^{-2}) (polymer)	$11 \cdot 10^{-4}$	
ΔSLD_L (nm^{-2})	$1.6 \cdot 10^{-4}$	
R_L (nm) (assumed)	9.67	
SLD_S (nm^{-2}) (AgNPs)	$78.4 \cdot 10^{-4}$	$59.0 \cdot 10^{-4}$
ΔSLD_{S-L} (nm^{-2})	$67.36 \cdot 10^{-4}$	$47.97 \cdot 10^{-4}$
$\frac{\Delta SLD_L}{\Delta SLD_{S-L}} \left(\frac{R_L}{R_S}\right)^3 (F)$	44.40	62.35
$n(+)$	239.8	191.8
$\sigma_n(+)$	6.5	7.0
$n(-)$	8.2	**20.3**
$\sigma_n(-)$	0.2	0.7

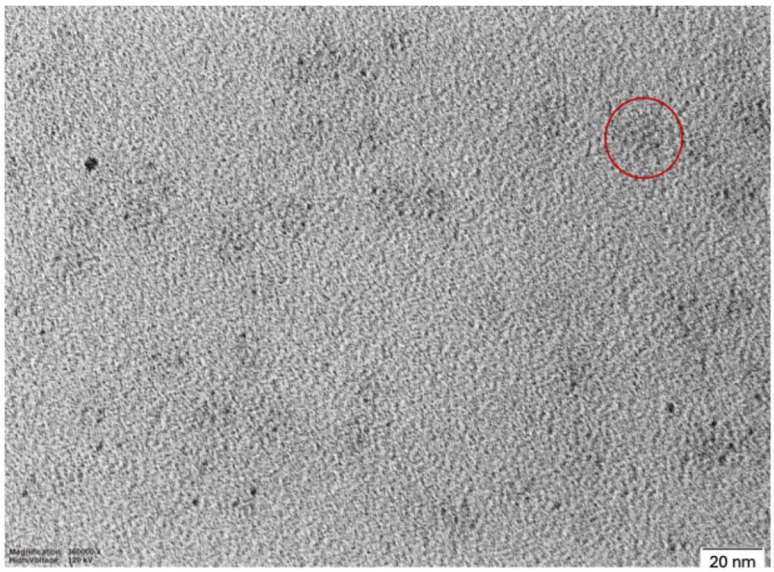

Figure S11. TEM images of AgNP / **H_{38}-*b*-$G4_{75}$** without PTA contrast agent. Micelles in aqueous solutions of [HIA] / :[Ag^+] / [NaOH]=1:1:1, [HIA] = 1.8 x 10^{-3} M stored for 20 months at 4°C. See **Figure 6a** for comparison.