

# Formation of Aggregate-Free Gold Nanoparticles in the Cyclodextrin-Tetrachloroaurate System Follows Finke–Watzky Kinetics

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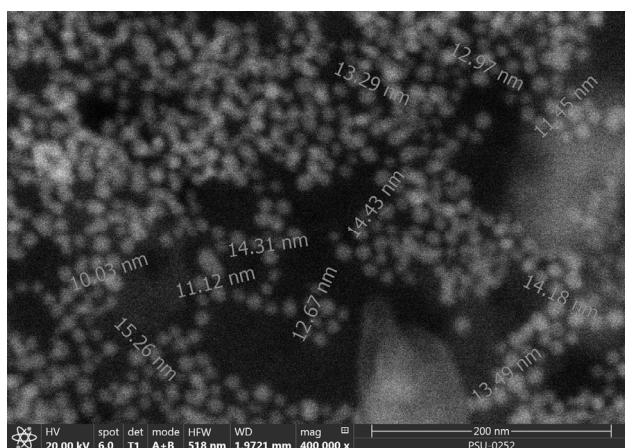
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**Table S1.** Recommended conditions for the synthesis of aggregate-free gold nanoparticles with immobilized cyclodextrins at room temperature.

Type	Cyclodextrin		Time, min	Centrifugation parameters		Average particle size, nm
	Concentration, M	pH		Speed, g	Duration, min	
$\alpha$	0.004	10.56	149 – 184; 768	7430	20	12-13
	0.002	11.5	413 – 613	7430	20	23-29
	0.004	11.5	288; 435 – 966	7430	20	1; 18; 22-25
$\beta$	0.004	10.56	93 – 210; 1172	7430	20	11.5-13
		11	195 – 546	13200	10	14-16
		11.5	125 – 280	7430	20	1; 37-42

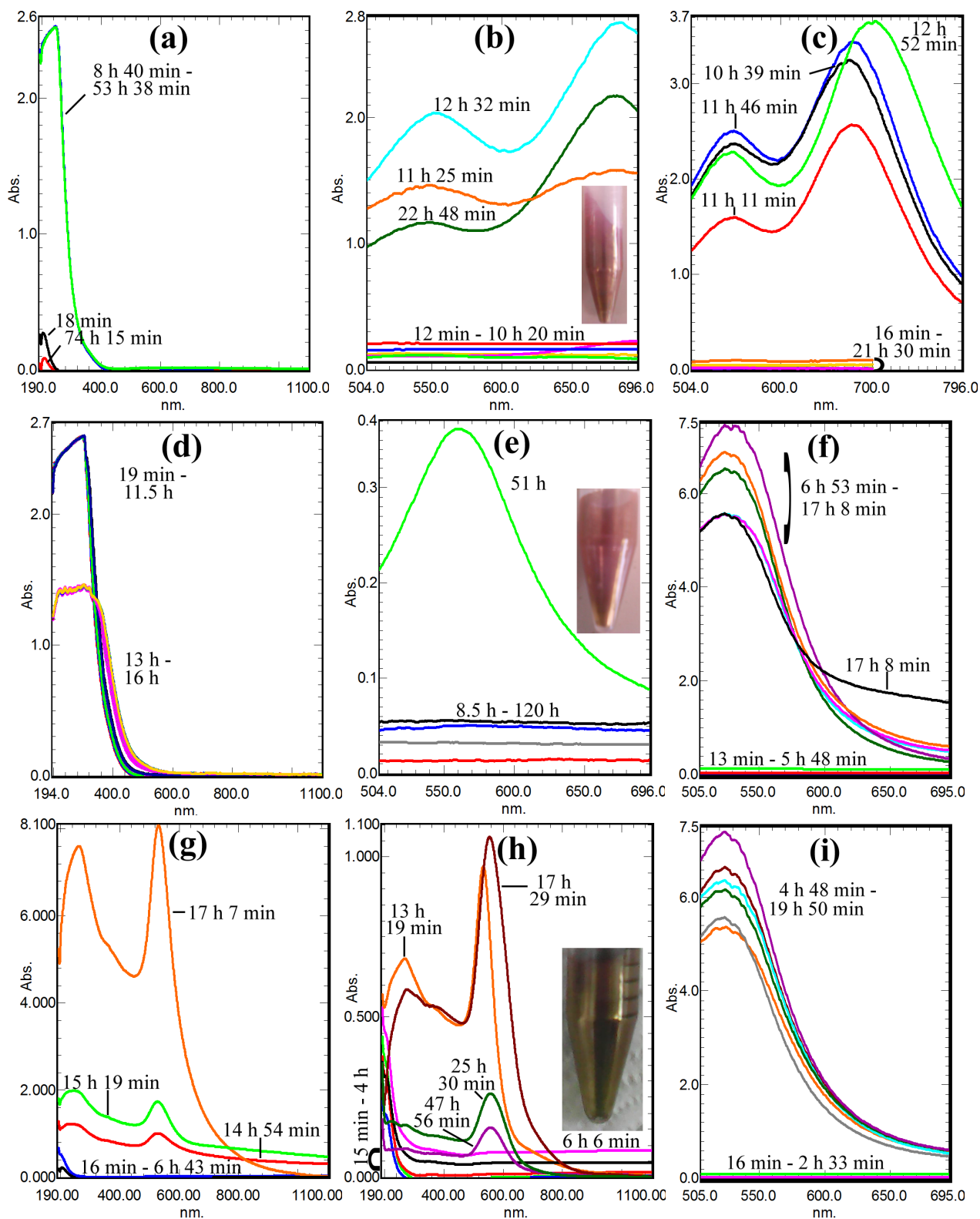


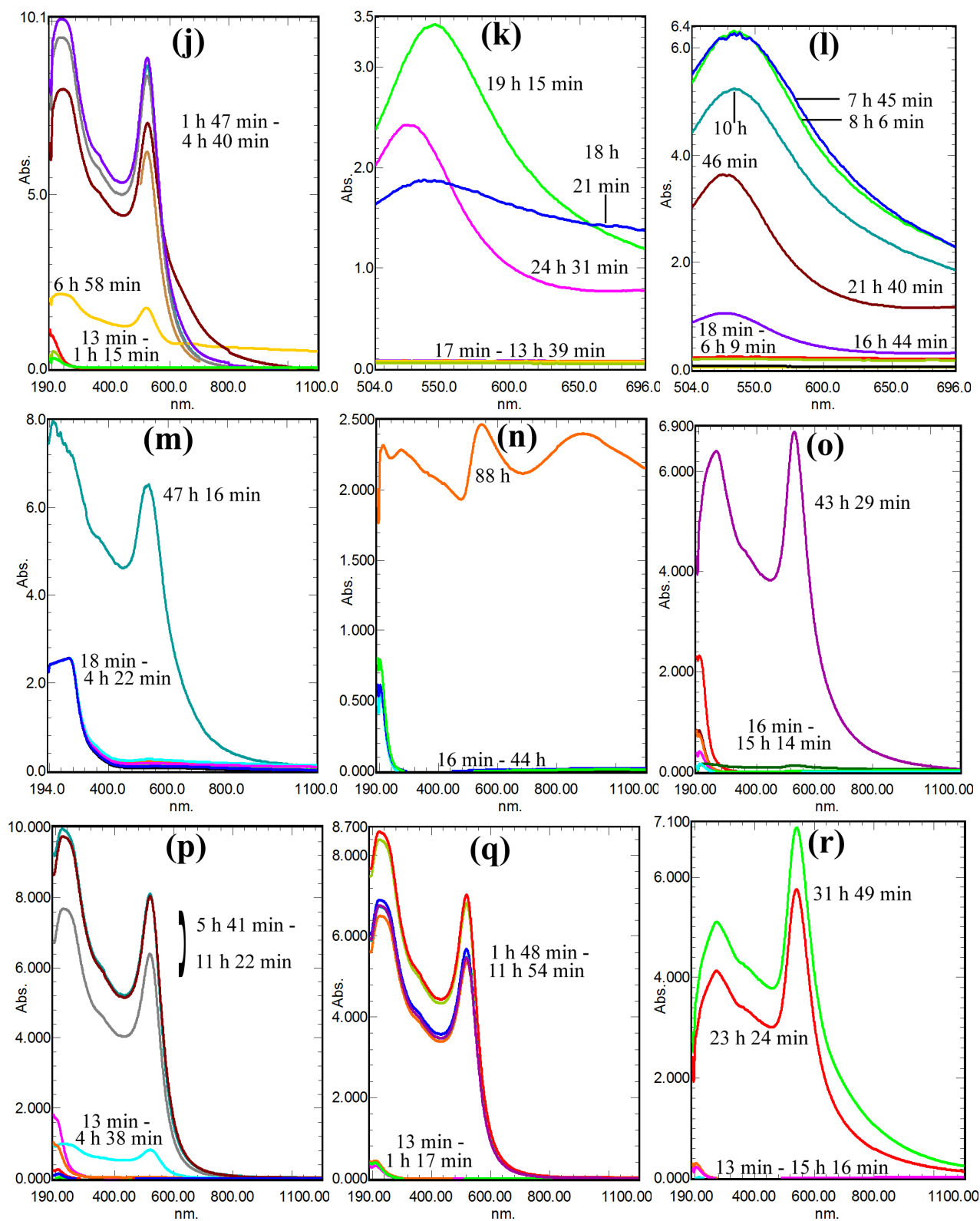
(a)

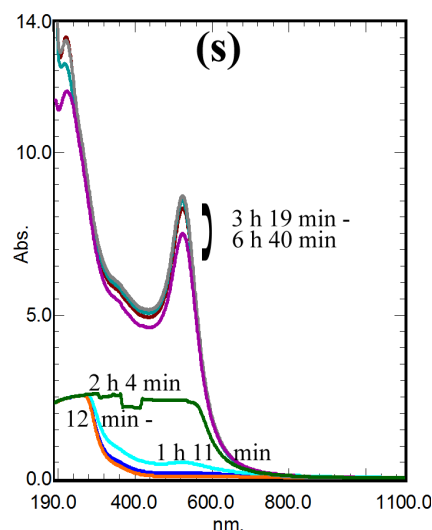


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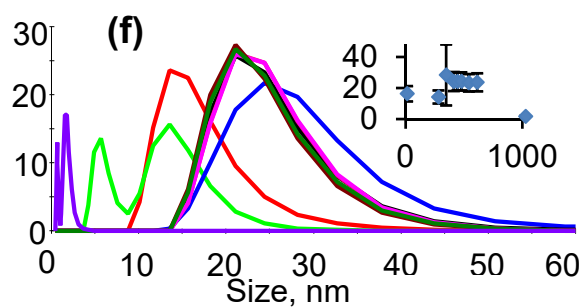
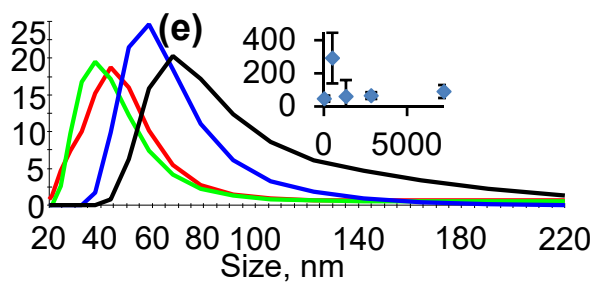
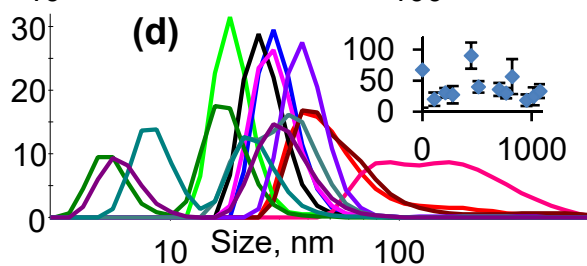
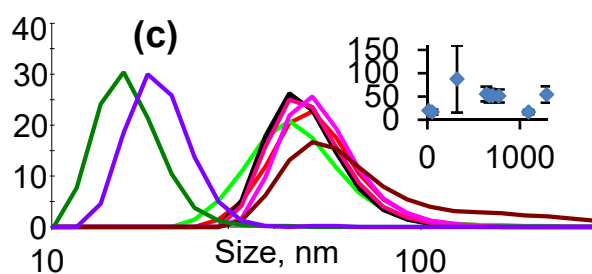
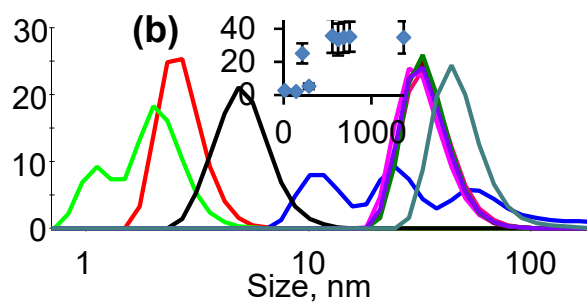
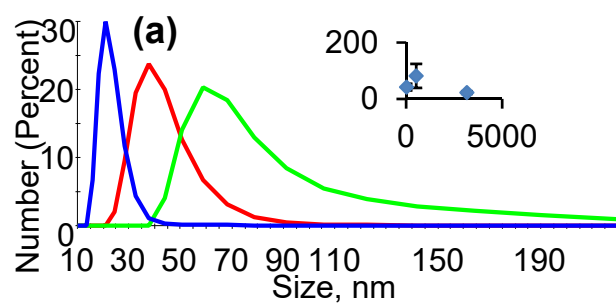
**Figure S1.** Scanning electron microscopy images of gold nanoparticles with immobilized (a)  $\alpha$ -cyclodextrin and (b)  $\gamma$ -cyclodextrin synthesized under reflux.

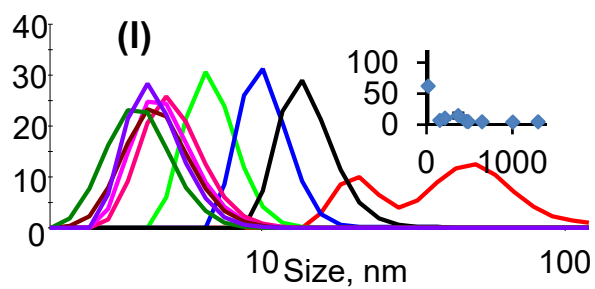
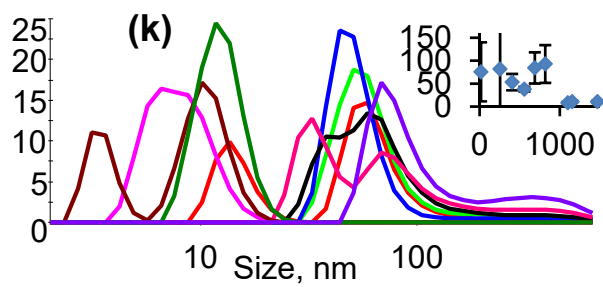
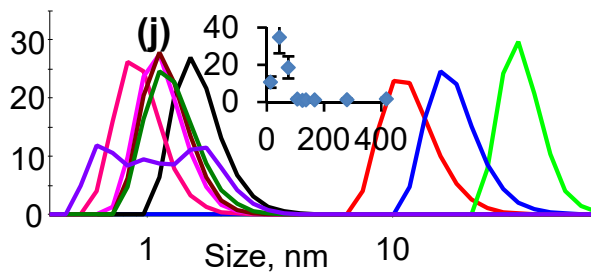
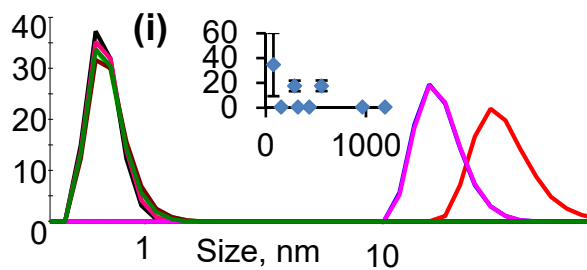
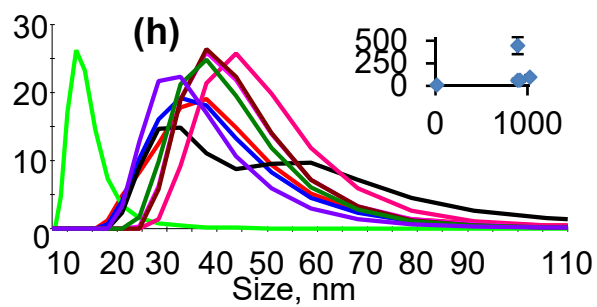
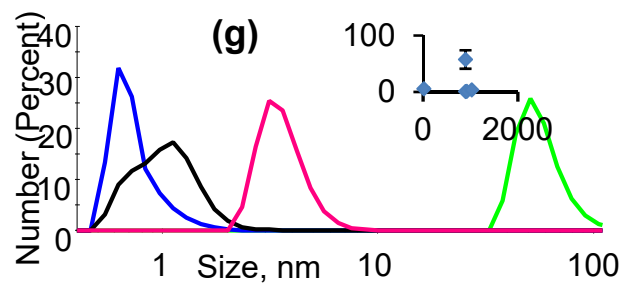


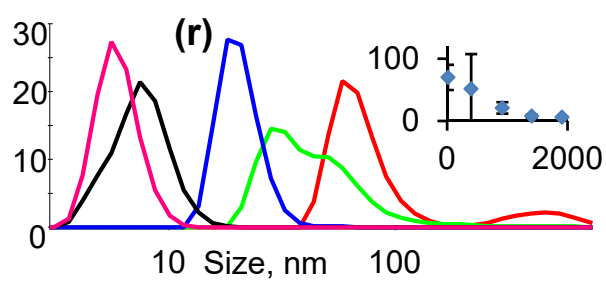
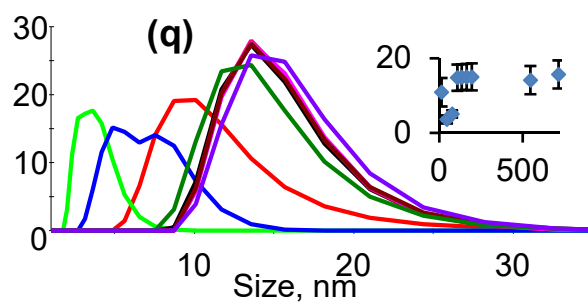
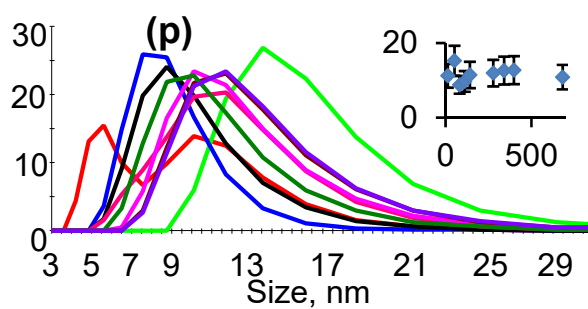
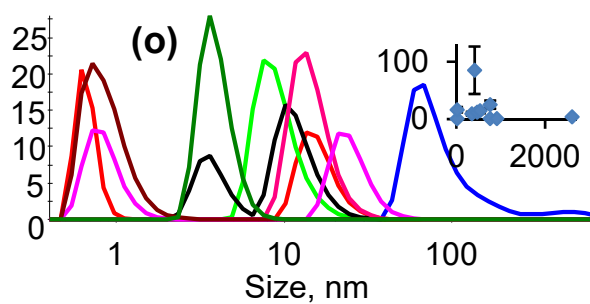
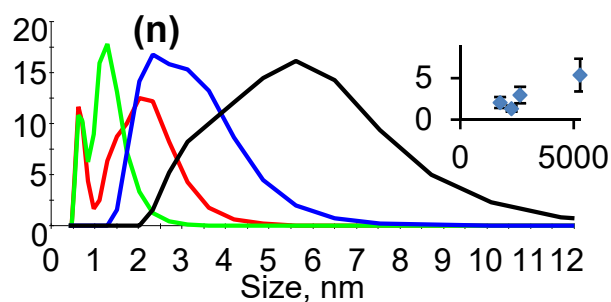
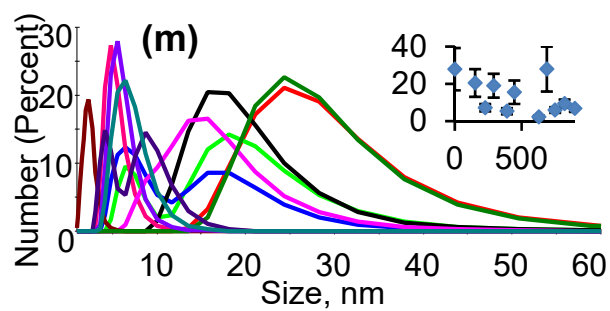




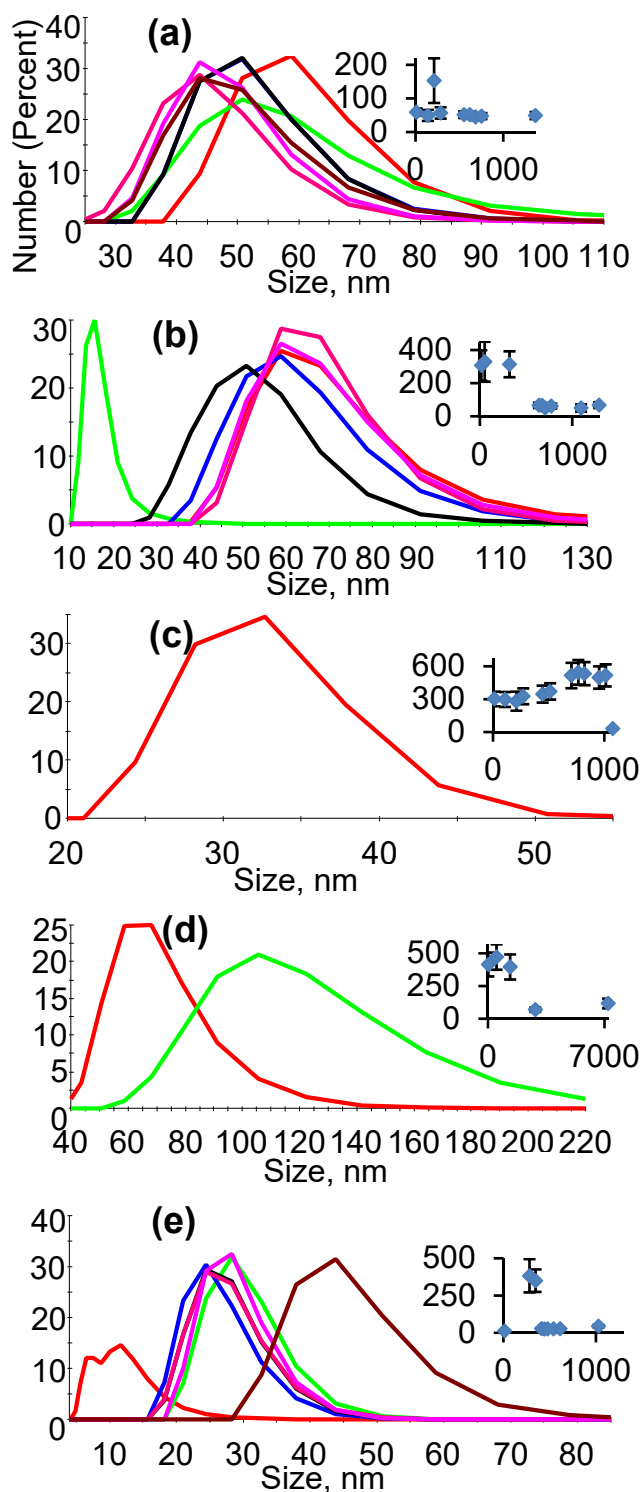
**Figure S2.** Absorbance spectra of gold nanoparticles synthesized at 0.1% (w/w)  $\text{HAuCl}_4$  at room temperature **(a)** at 0.001 M  $\gamma$ -cyclodextrin, pH 10.56; at pH 12: **(b)** at 0.004 M  $\alpha$ -cyclodextrin; **(c)** at 0.004 M  $\beta$ -cyclodextrin; **(d)** at 0.004 M  $\gamma$ -cyclodextrin; at pH 11.5: **(e)** at 0.001 M  $\alpha$ -cyclodextrin; **(f)** at 0.002 M  $\alpha$ -cyclodextrin; **(g)** at 0.002 M  $\alpha$ -cyclodextrin in the absence of HCl; **(h)** at 0.002 M  $\alpha$ -cyclodextrin in the presence of NaCl; **(i)** at 0.004 M  $\alpha$ -cyclodextrin; **(j)** at 0.004 M  $\beta$ -cyclodextrin; **(k)** at 0.001 M  $\gamma$ -cyclodextrin; **(l)** at 0.002 M  $\gamma$ -cyclodextrin; **(m)** at 0.004 M  $\gamma$ -cyclodextrin; at pH 11: **(n)** at 0.001 M  $\alpha$ -cyclodextrin; **(o)** at 0.002 M  $\alpha$ -cyclodextrin; **(p)** at 0.004 M  $\alpha$ -cyclodextrin; **(q)** at 0.004 M  $\beta$ -cyclodextrin; **(r)** at 0.002 M  $\gamma$ -cyclodextrin; **(s)** at 0.004 M  $\gamma$ -cyclodextrin. The respective 'golden mirrors' are shown as insets.



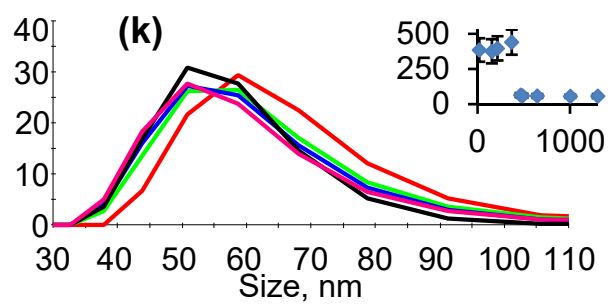
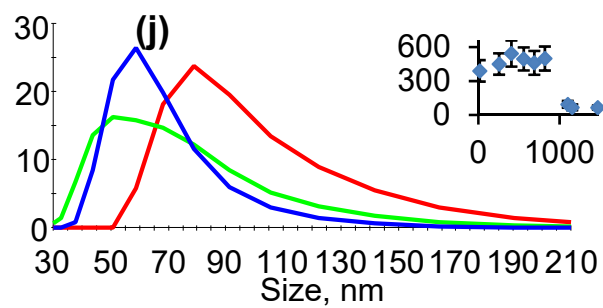
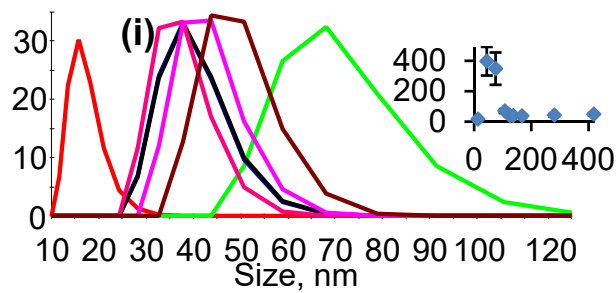
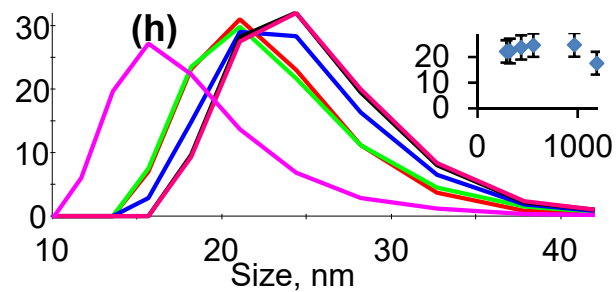
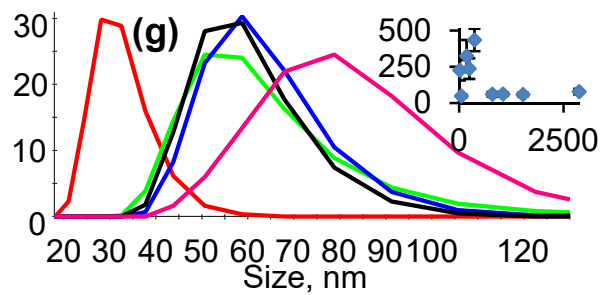
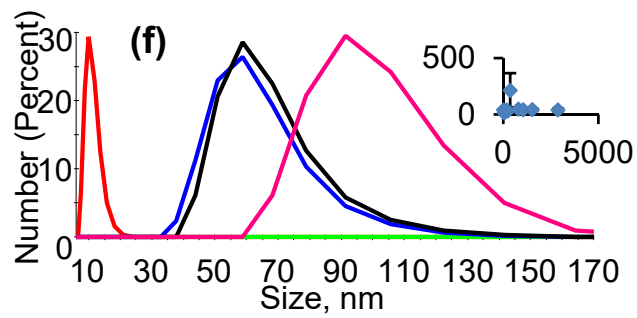


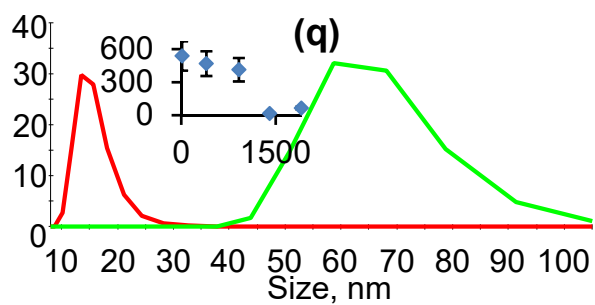
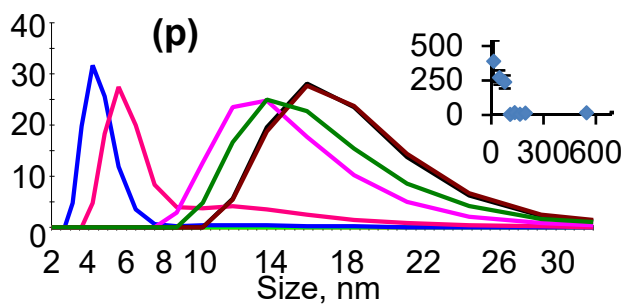
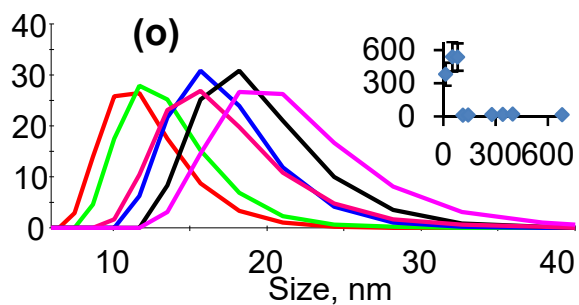
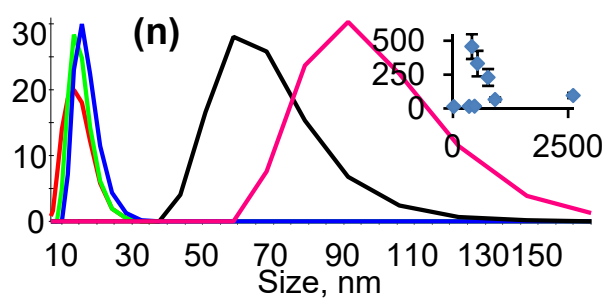
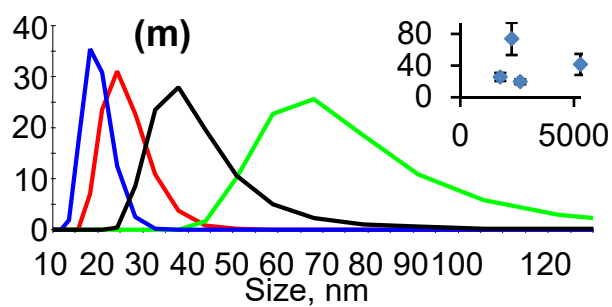
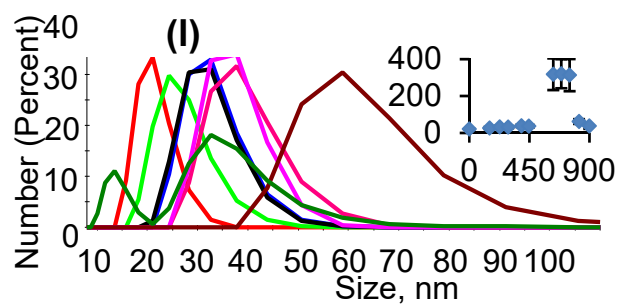


**Figure S3.** Number size distributions of gold nanoparticles synthesized at 0.1% (w/w) HAuCl<sub>4</sub> at room temperature **(a)** at 0.001 M  $\gamma$ -cyclodextrin, pH 10.56; at pH 12: **(b)** at 0.004 M  $\alpha$ -cyclodextrin; **(c)** at 0.004 M  $\beta$ -cyclodextrin; **(d)** at 0.004 M  $\gamma$ -cyclodextrin; at pH 11.5: **(e)** at 0.001 M  $\alpha$ -cyclodextrin; **(f)** at 0.002 M  $\alpha$ -cyclodextrin; **(g)** at 0.002 M  $\alpha$ -cyclodextrin in the absence of HCl; **(h)** at 0.002 M  $\alpha$ -cyclodextrin in the presence of NaCl; **(i)** at 0.004 M  $\alpha$ -cyclodextrin; **(j)** at 0.004 M  $\beta$ -cyclodextrin; **(k)** at 0.001 M  $\gamma$ -cyclodextrin; **(l)** at 0.002 M  $\gamma$ -cyclodextrin; **(m)** at 0.004 M  $\gamma$ -cyclodextrin; at pH 11: **(n)** at 0.001 M  $\alpha$ -cyclodextrin; **(o)** at 0.002 M  $\alpha$ -cyclodextrin; **(p)** at 0.004 M  $\alpha$ -cyclodextrin; **(q)** at 0.004 M  $\beta$ -cyclodextrin; **(r)** at 0.002 M  $\gamma$ -cyclodextrin. The data were acquired in back-scattering mode. The insets show the dependence of the main number size distribution peak (nm) on reaction time (min). Samples containing only aggregates were omitted from the main plots but not from the insets.

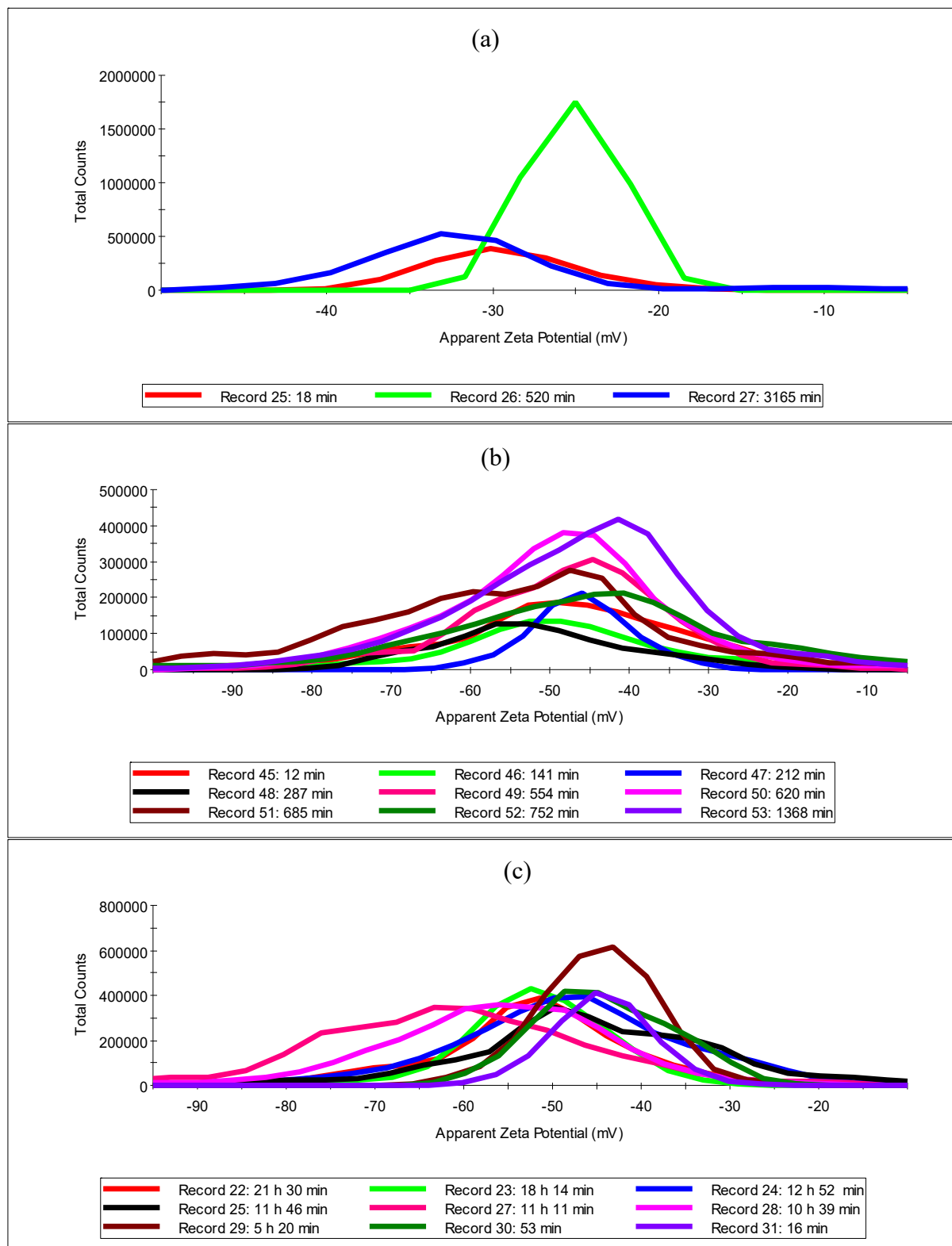


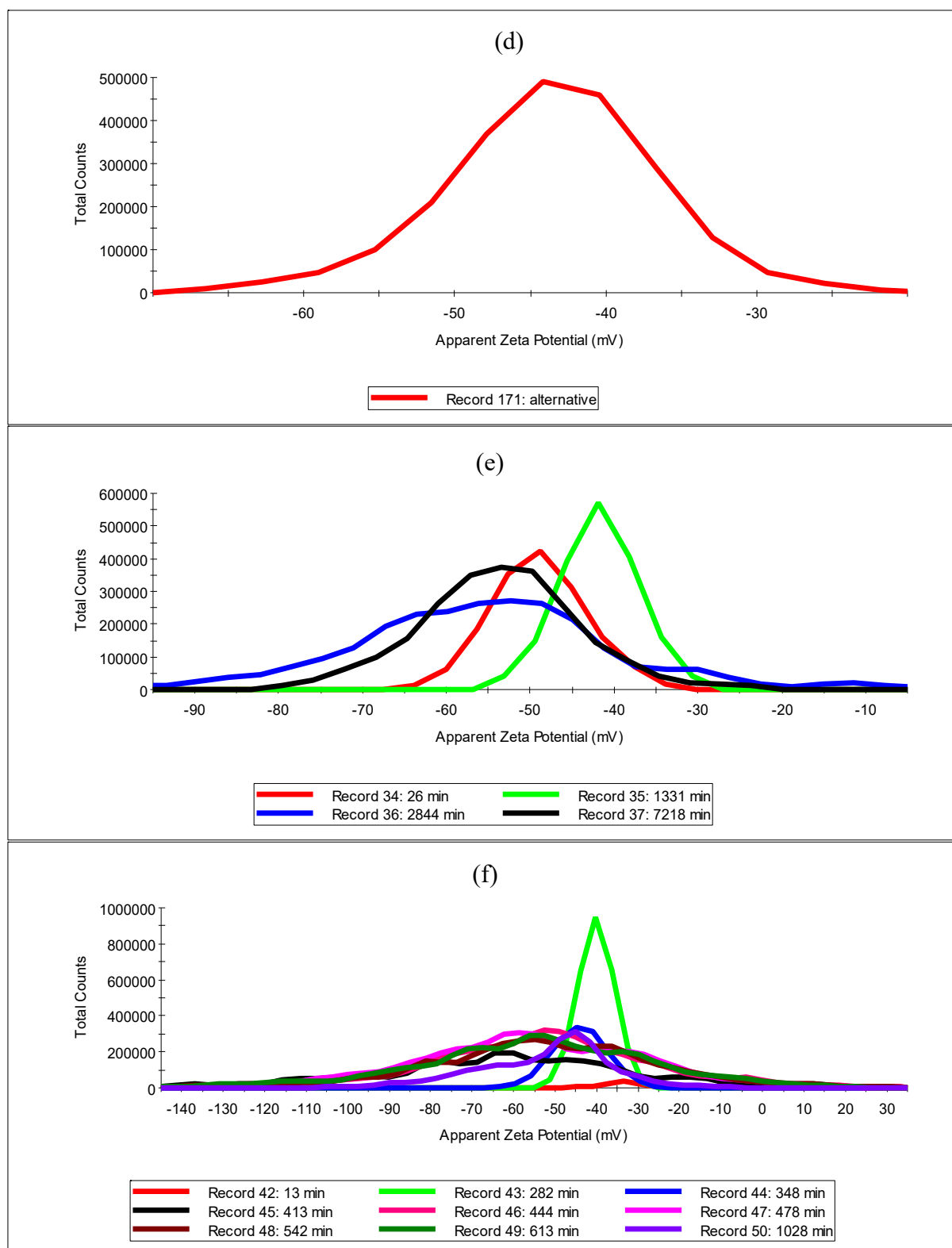


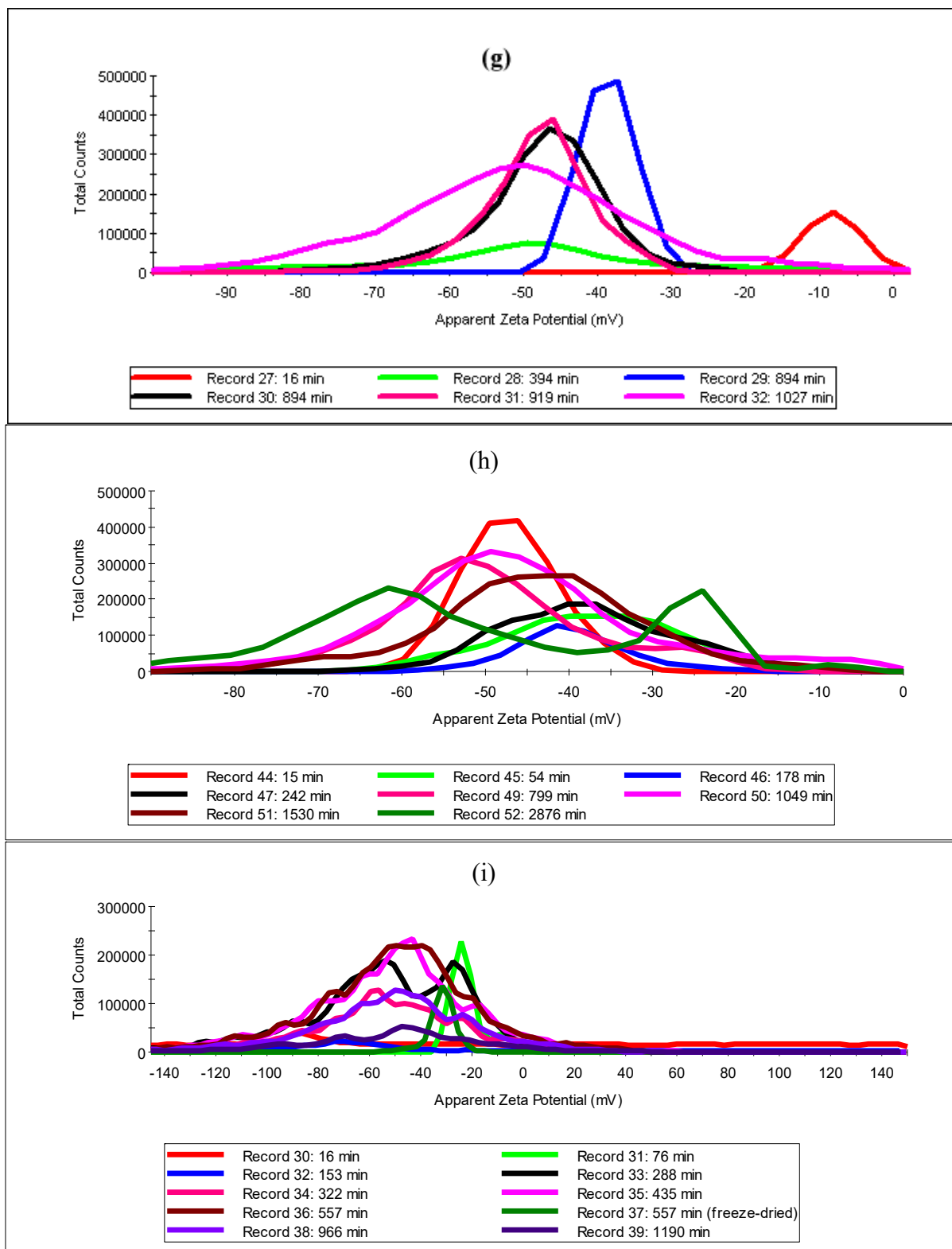


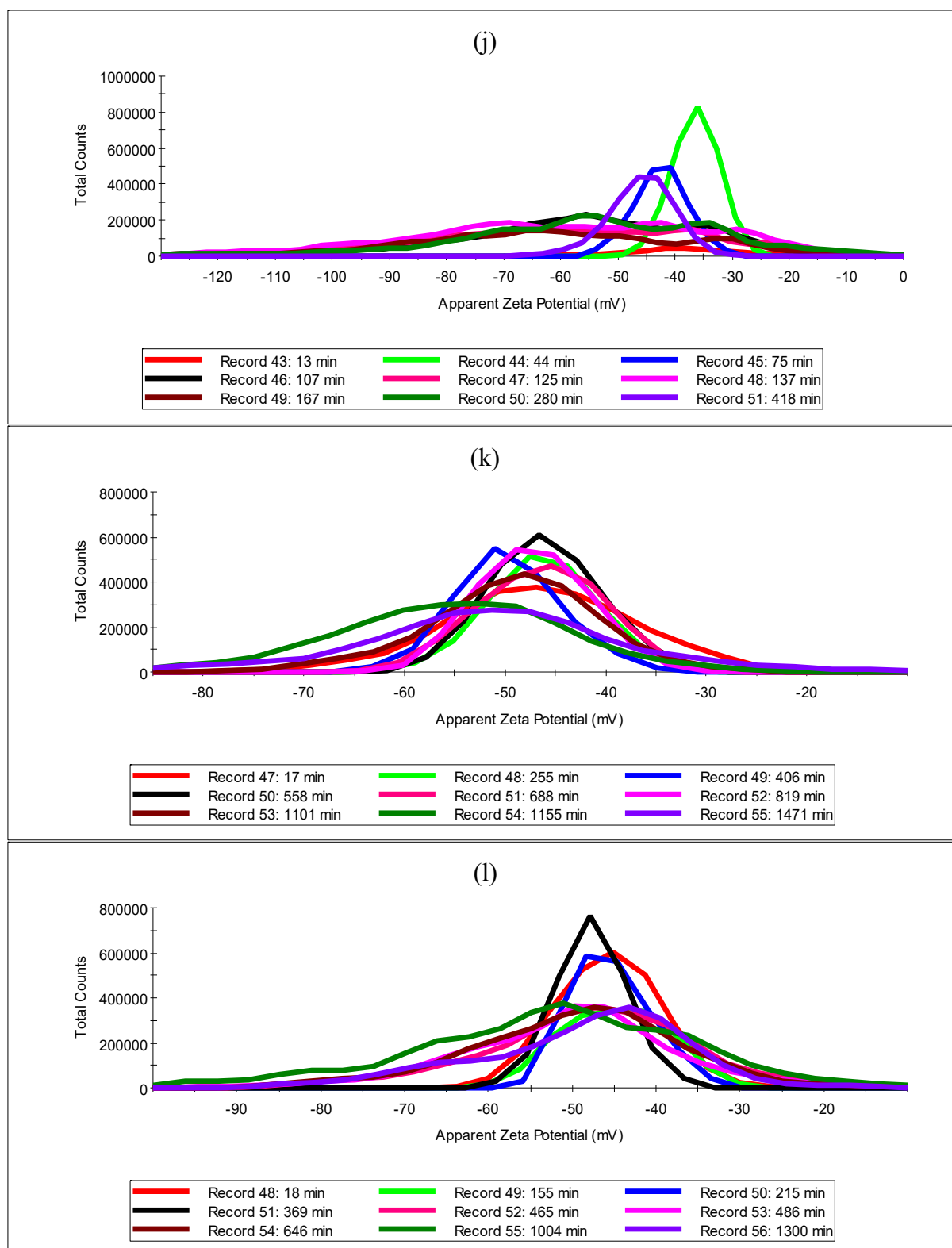


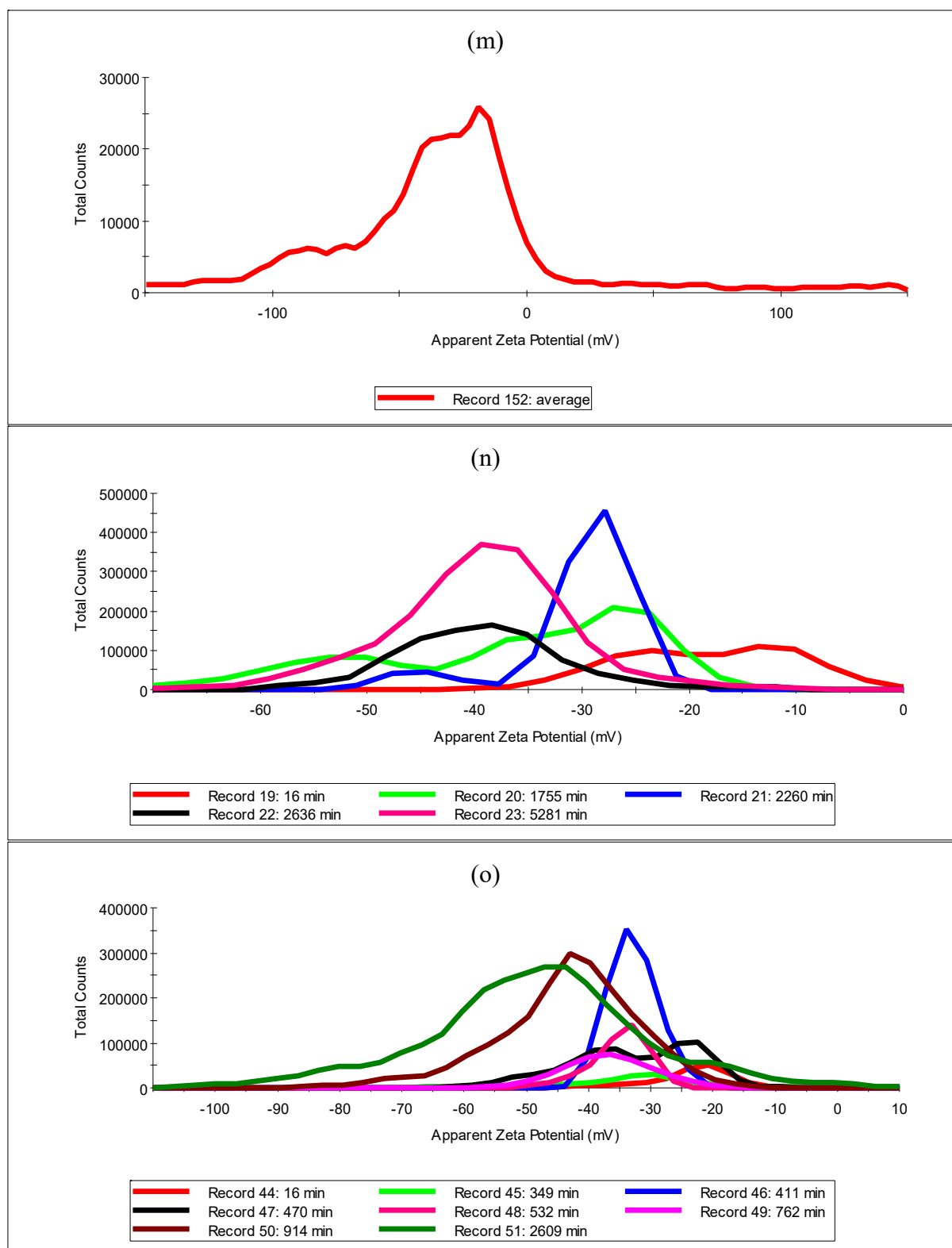
**Figure S4.** Number size distributions of gold nanoparticles synthesized at 0.1% (w/w)  $\text{HAuCl}_4$  at room temperature at pH 12: **(a)** at 0.004 M  $\alpha$ -cyclodextrin; **(b)** at 0.004 M  $\beta$ -cyclodextrin; **(c)** at 0.004 M  $\gamma$ -cyclodextrin; at pH 11.5: **(d)** at 0.001 M  $\alpha$ -cyclodextrin; **(e)** at 0.002 M  $\alpha$ -cyclodextrin; **(f)** at 0.002 M  $\alpha$ -cyclodextrin in the absence of HCl; **(g)** at 0.002 M  $\alpha$ -cyclodextrin in the presence of NaCl; **(h)** at 0.004 M  $\alpha$ -cyclodextrin; **(i)** at 0.004 M  $\beta$ -cyclodextrin; **(j)** at 0.001 M  $\gamma$ -cyclodextrin; **(k)** at 0.002 M  $\gamma$ -cyclodextrin; **(l)** at 0.004 M  $\gamma$ -cyclodextrin; at pH 11: **(m)** at 0.001 M  $\alpha$ -cyclodextrin; **(n)** at 0.002 M  $\alpha$ -cyclodextrin; **(o)** at 0.004 M  $\alpha$ -cyclodextrin; **(p)** at 0.004 M  $\beta$ -cyclodextrin; **(q)** at 0.002 M  $\gamma$ -cyclodextrin. The data were acquired in forward-scattering mode. The insets show the dependence of the main number size distribution peak (nm) on reaction time (min). Samples containing only aggregates were omitted from the main plots but not from the insets.

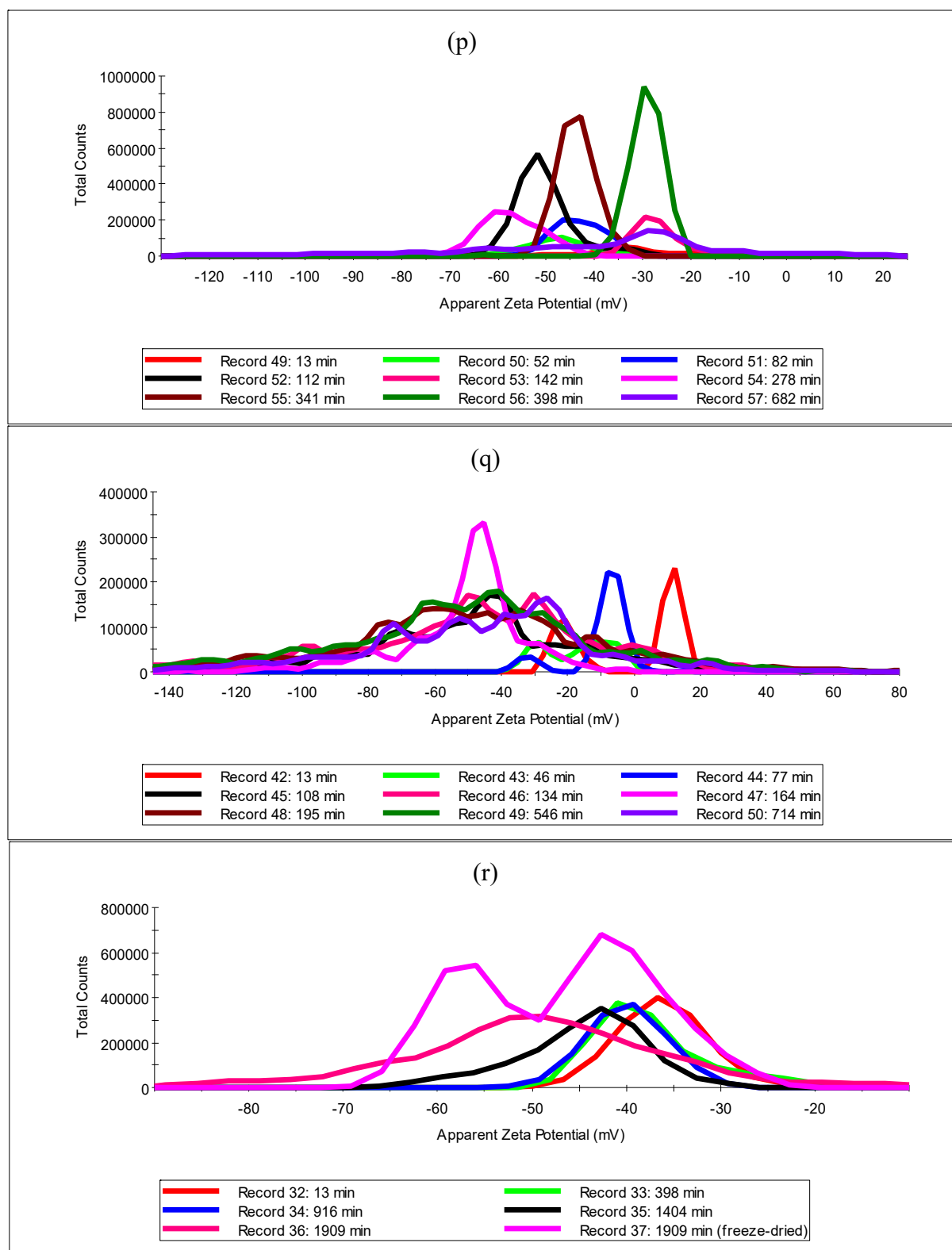






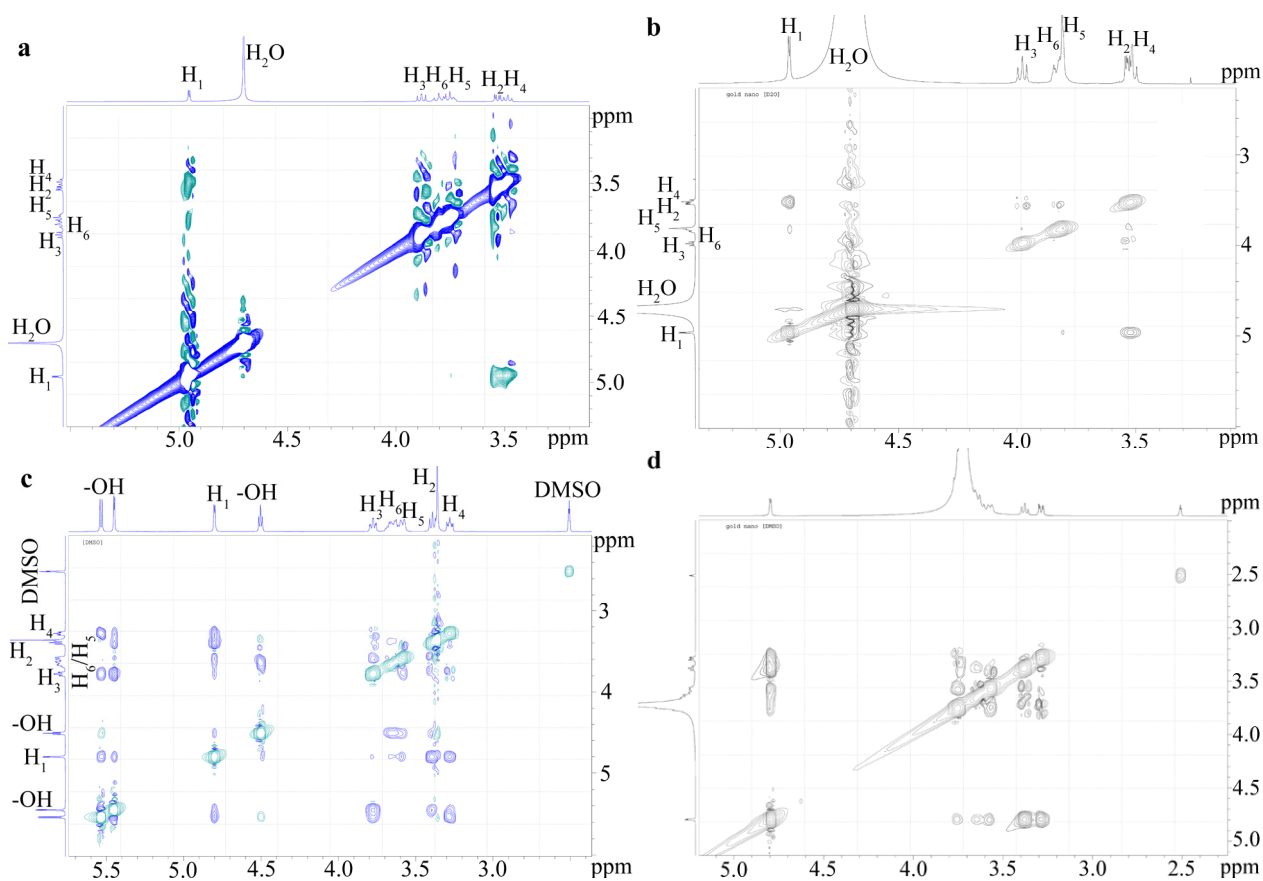






**Figure S5.** Zeta potential distributions of gold nanoparticles synthesized at 0.1% (w/w)  $\text{HAuCl}_4$  at room temperature **(a)** at 0.001 M  $\gamma$ -cyclodextrin, pH 10.56; at pH 12: **(b)** at 0.004 M  $\alpha$ -cyclodextrin; **(c)** at 0.004 M  $\beta$ -cyclodextrin; **(d)** at 0.004 M  $\gamma$ -cyclodextrin after 18.5 h; at pH 11.5: **(e)** at 0.001 M  $\alpha$ -cyclodextrin; **(f)** at 0.002 M  $\alpha$ -cyclodextrin; **(g)** at 0.002 M  $\alpha$ -cyclodextrin in the absence of HCl; **(h)** at 0.002 M  $\alpha$ -cyclodextrin in the presence of NaCl; **(i)** at 0.004 M  $\alpha$ -cyclodextrin; **(j)** at 0.004 M  $\beta$ -cyclodextrin; **(k)** at 0.001 M  $\gamma$ -cyclodextrin; **(l)** at 0.002 M  $\gamma$ -cyclodextrin; **(m)** at 0.004 M  $\gamma$ -cyclodextrin after 16 h; at pH 11: **(n)** at 0.001 M  $\alpha$ -cyclodextrin; **(o)** at 0.002 M  $\alpha$ -cyclodextrin; **(p)** at 0.004 M  $\alpha$ -cyclodextrin; **(q)** at 0.004 M  $\beta$ -cyclodextrin; **(r)** at 0.002 M  $\gamma$ -cyclodextrin. Samples containing only aggregates were omitted for clarity.





**Figure S6.** ROESY spectra of  $\alpha$ -cyclodextrin alone (a,c) and in the presence of  $\text{H[AuCl}_4\text{]}$  at pH 6.16 (b,d) in  $\text{D}_2\text{O}$  (a,b) and in DMSO (c,d).