Nanosupernova: a new anisotropic nanostructure for SERS

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Au/AgNSs

Table S1. DLS and Zeta-potential Data for the Au/AgNSs and Au/AgNSs@DTNB

Sample	Size (nm)	PDI	Zeta-Potential (mV)
Au/AgNSs	67.7 ± 1.0	0.312	-32.3 ± 9.6
Au/AgNSs@DTNB	77.8 ± 0.3	0.281	$-36.\ 4 \pm 9.4$

DTNB peak assignments

Table S2. Analysis of SERS spectrum of DTNB

Peak (cm^{-1})	Vibrational Mode
245	Au-S vib
331	COOH and -NO_2 vib
532	CH_2 out of plane
737	NO_2
845	OH in COOH out of plane
1056	CH in ring out of plane
1100	C-N str
1152	C-S str
1291-1342	NO2 symm str
1463	C-H in -CH_2 scissoring
1557	C=C in plane deformation

Optimisation of the silver coating conditions

Initial experiments were conducted to find the optimal conditions for the silver coating. In one experiment 30 μL, 60 μL and 90 μL of 10 mM $AgNO_3$ was added to 1 mL samples of Au/AgNSs@DTNB, followed by 30 μL of hydroquinone. It was found that 90 μL of $AgNO_3$ was the best condition to ensure the formation of both SERS nanotags and SERS nanosupernova. Although SERS nanotags formed for all three conditions, increasing in size slightly with the addition of more $AgNO_3$. UV-Visible absorbance and SERS spectra for the experiment are shown in **Figure S1**.

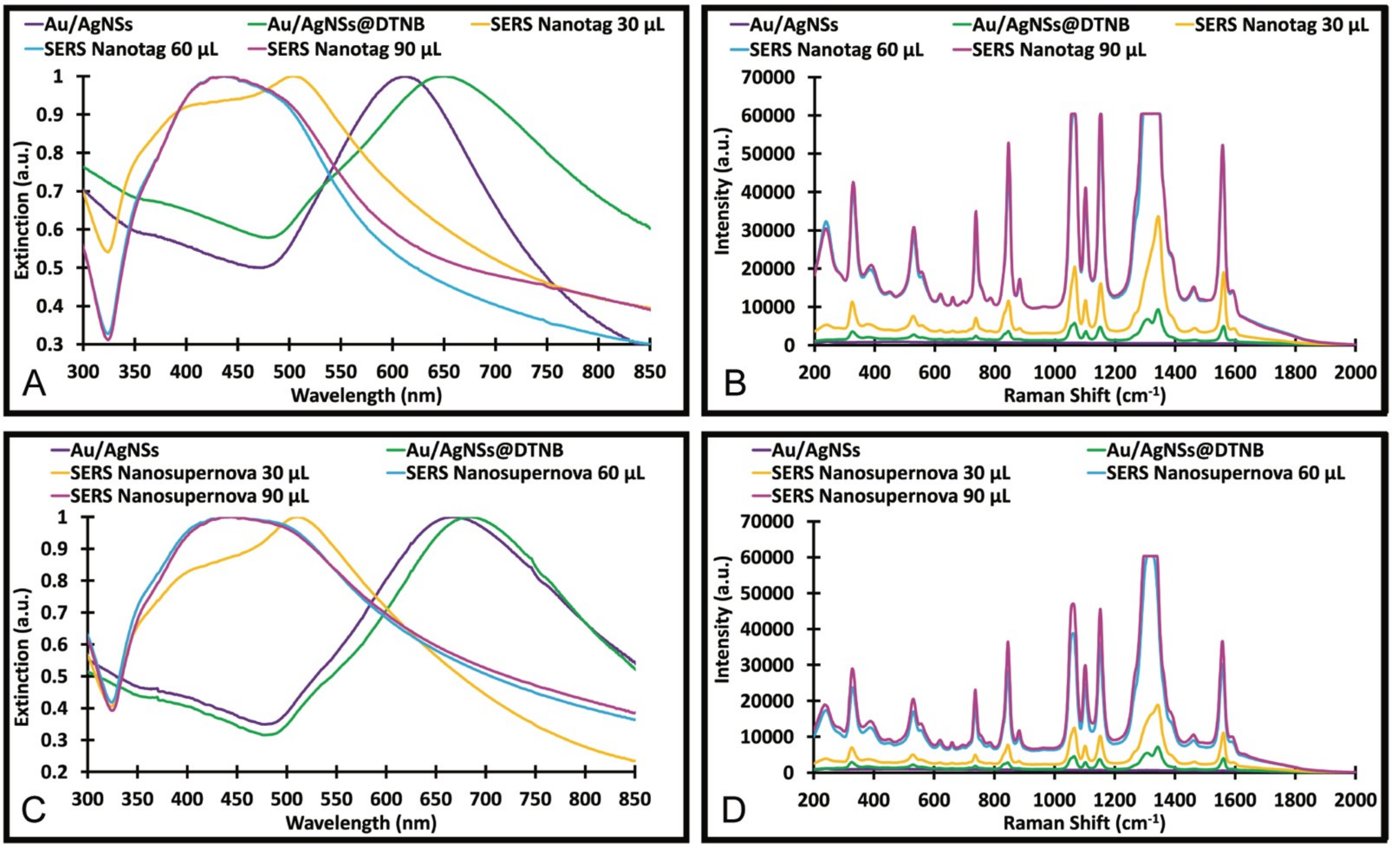

Figure S1. UV-Visible spectra and SERS spectra of the SERS nanotags with 30 μL, 60 μL and 90 μL of 10 mM $AgNO_3$ (A and B) and the SERS nanosupernova with 30 μL, 60 μL and 90 μL of 10 mM $AgNO_3$ (C and D). All spectra include Au/AgNSs and Au/AgNSs@DTNB samples for reference.

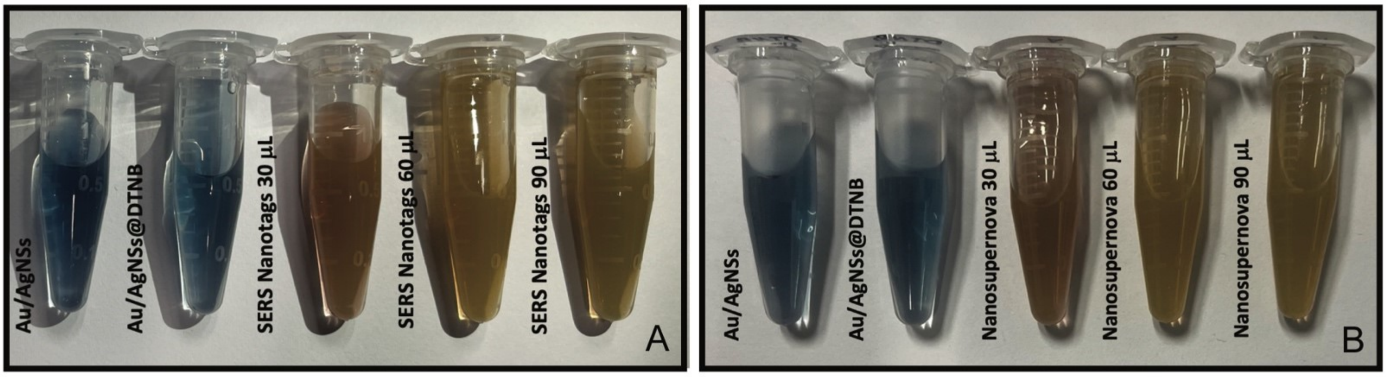

Figure S2. Photographs of the SERS nanotags with 30 μL, 60 μL and 90 μL of 10 mM $AgNO_3$ (A) and the SERS nanosupernova with 30 μL, 60 μL and 90 μL of 10 mM $AgNO_3$ (B). Photographs include Au/AgNSs and Au/AgNSs@DTNB samples for reference.

Table S3. DLS and Zeta-potential Data for the SERS Nanotags and Nanosupernova

Sample	Size (nm)	PDI	Zeta-Potential (mV)
SERS Nanotags 30 μL	97.1 ± 1.1	0.269	-35.2 ± 7.1
SERS Nanotags 60 μL	111.4 ± 0.4	0.232	-32.9 ± 6.1
SERS Nanotags 90 μL	108.7 ± 0.8	0.202	-29.5 ± 8.0
SERS Nanosupernova 30 μL	99.0 ± 1.2	0.243	-30.6 ± 6.5
SERS Nanosupernova 60 μL	111.8 ± 2.3	0.239	-32.0 ± 6.0
SERS Nanosupernova 90 μL	428.5 ± 72.2	0.223	-32.5 ± 6.2

Effect of Various Shaking Conditions on Nanosupernova Morphology

When optimising the nanosupernova several variations of the shaking conditions were trialled. In the first set of experiments the shaking time was 12 hours at 750 rpm which formed the larger structure seen in **Figure S3A**. The next set of experiments tried using 1500 rpm for 10 minutes, followed by shaking at 750 rpm for the remainder of the 12 hours. Samples in a batch were all added to the shaker at the same time once the $AgNO_3$ and hydroquinone had been added and the morphology seen in **Figure S3B** formed. Subsequently the same method was used, but samples were added immediately to the shaker as soon as the $AgNO_3$ and hydroquinone were added. This resulted in nanosupernova with distinct and shape protrusions as seen in **Figure S3C** and was the final method selected to make nanosupernova.

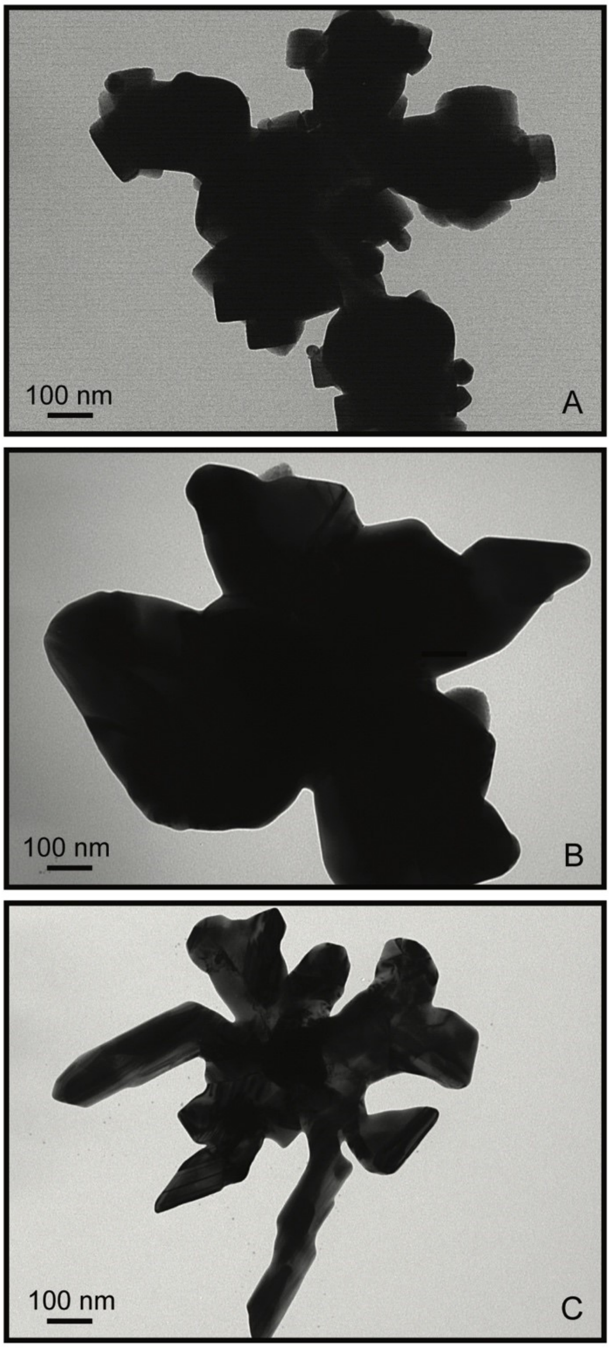

Figure S3. TEM images showing the effect of various shaking conditions on the morphology of the resulting particles. Image A shows a particle formed when 12 hours of shaking at 750 rpm was used. Image B and C show the particles formed when 10 minutes of shaking at 1500 rpm and shaking at 750 for the remainder of the 12 hours was used. For the particles in Image B, all samples in a batch were prepared and then added to the shaker. For the particles in Image C, individual samples were added immediately to the shaker after the addition of the $AgNO_3$ and hydroquinone.

Additional nanosupernova simulated enhanced electric field distribution images

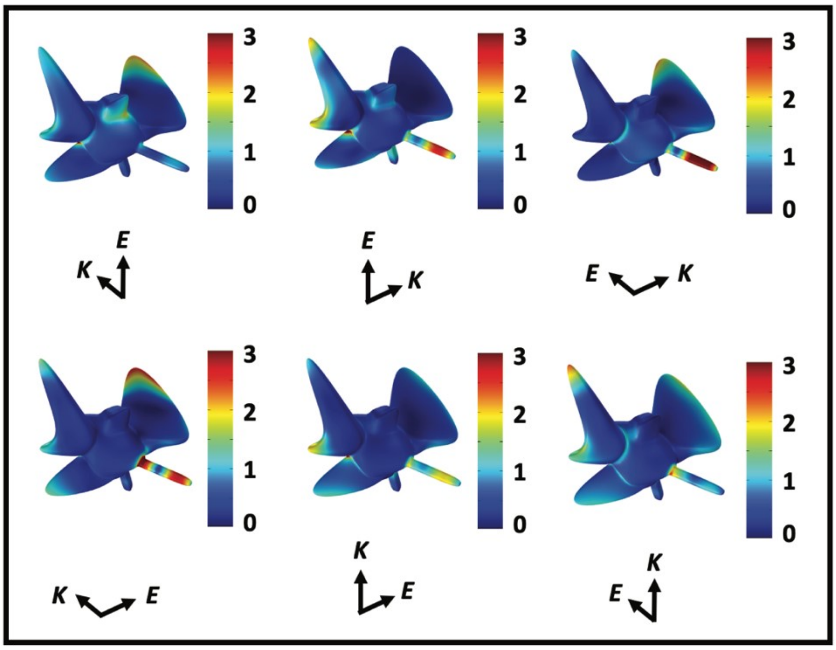

Figure S4. Additional images of the simulated enhanced electric field distribution around the Nanosupernova. *E* is the polarisation direction and *K* is the propagation direction. The wavelength of the incident light is 785 nm.