**Supplementary Information**

# Environmentally benign synthesis of virus-templated, monodisperse, iron-platinum nanoparticles.

**Sachin N. Shah, Nicole F. Steinmetz,[a] Alaa A. A. Aljabali, George P. Lomonossoff and David. J. Evans***

Department of Biological Chemistry, John Innes Centre, Norwich Research Park, Colney, Norwich, NR4 7UH (United Kingdom)

Fax: +44-(0)1603-450018

E-mail: dave.evans@bbsrc.ac.uk

[a] Present address: Department of Cell Biology and Centre of Integrated Molecular Biosciences, The Scripps Research Institute, 10550 North Torrey Pines Road, La Jolla, CA 92037, USA.

## Instrumentation

- Transmission Electron Microscope (TEM) – Carbon-coated copper EM grids (400 mesh, Agar Scientific) on TEM JEOL 1200EX.
- Selected Area Electron Diffraction (SAED) – Philips 420 TEM at working voltage of 120 KV.
- Energy dispersive X-ray Spectroscopy (EDXS) – OXFORD INCA Energy 200Premium.
- Nanoparticle Tracking Analysis – NanoSight VM 10 instrument.
- Dynamic Light Scattering (DLS) – DynaPro Titan, Wyatt Technology Corporation.
- Zeta Potential – Malvern Instruments Zetasizer Nano.

**Cloning Procedure**

Oligonucleotides encoding the peptide of interest, flanked by appropriate restriction sites (*Nhe*I and *Aat*II), were cloned into the CPMV RNA2-based vector, pCP2.[1] In a second cloning step the chimaeric sequence was cloned *via* the enzymes *Bam*HI and *Eco*RI into the CPMV RNA-2 based binary vector pBinP-NS1.[2] The resulting recombinant pBinP-NS1-based clone, termed, pBinP-NS1-FEPT, was used to agroinoculate cowpea (*Vigna unguiculata*) plants in the presence of the full-length clone of RNA-1, pBinP-S1NT. Plants were maintained in a greenhouse as previously described.[2]

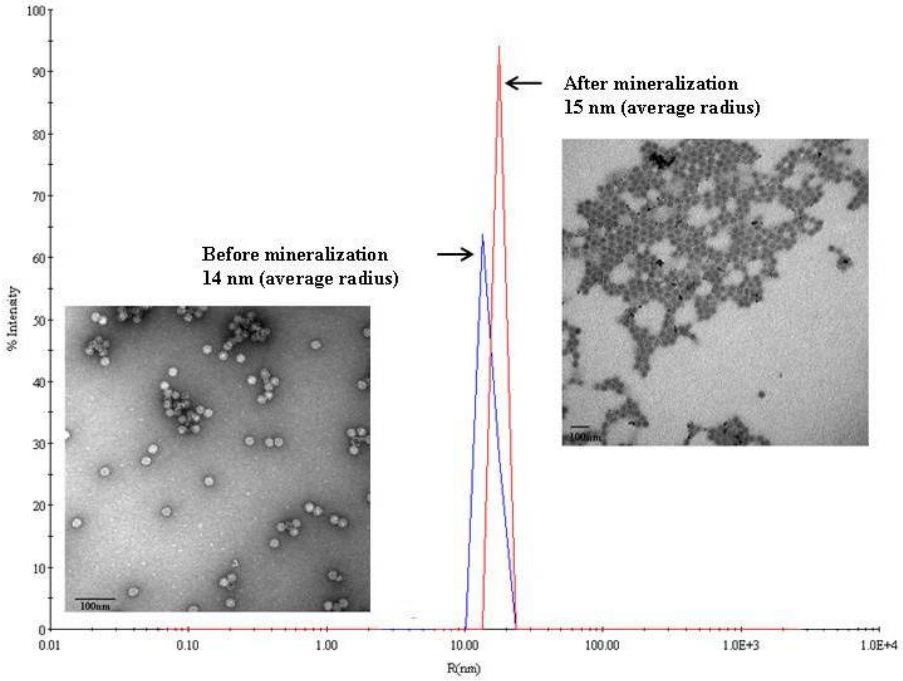
**Chimaera Virus Propagation and Purification**

To scale-up the production of virus particles, plant sap or purified virions were used to inoculate further cowpea plants.[3] Virus particles were purified and the concentration of virions determined by Bradford assay or spectrophotometrically as previously described.[4]

**FePt coating of $CPMV_{FePt}$ Chimaera**

Chimaeric $CPMV_{FePt}$ (10 mg/ml, 200 μmol) in 10 mM sodium phosphate buffer of pH 7 was treated with 200 μl of a 1:1 mixture of 0.05 mol $dm^{-3}$ $FeCl_3$ and 0.05 mol $dm^{-3}$ $H_2PtCl_6$ and 200 μl of 0.1 mol $dm^{-3}$ $NaBH_4$, in 10 mM sodium phosphate buffer pH 7, added with constant stirring over 10 min at room temperature. After a further 3 days stirring at ambient temperature the FePt-coated $CPMV_{FePt}$ nanoparticles were then recovered from the reaction mixture by centrifugation at 14000 r.p.m. for 10 min, the supernatant containing FePt-coated $CPMV_{FePt}$ nanoparticles was passed through 100 K Millipore cut-off columns and washed several times with Mill-Q water. The recovery of purified FePt-coated $CPMV_{FePt}$ nanoparticles was approximately 55 % based on initial virus concentration. Control experiments with wild-type CPMV were performed under identical conditions.

**Dynamic light scattering.**

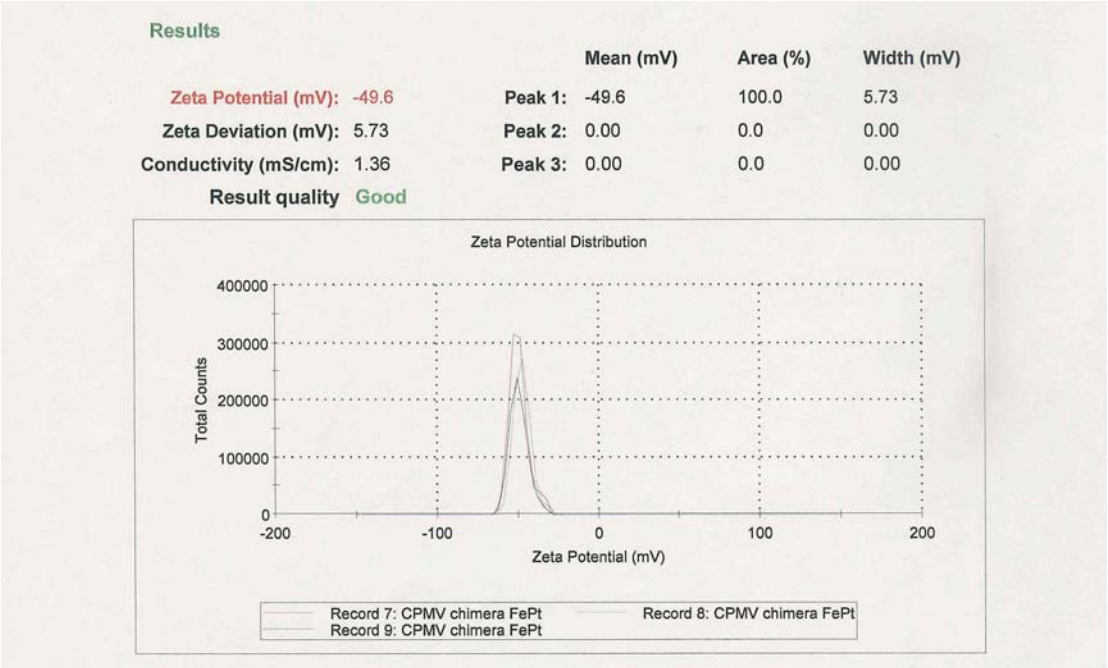



**Supporting Figure 1. Dynamic light scattering.**

Dynamic light scattering (DLS) comparing $CPMV_{FePt}$ chimaera (blue line) and FePt - coated $CPMV_{FePt}$ particles (red line). Average radius increases by 1nm after mineralization.

**Zeta Potential Measurement.**

1 ml of 0.05 mg/ml FePt-coated $CPMV_{FePt}$ particles dispersed in 10 mM sodium phosphate buffer pH 7.2 was prepared. Zeta cells were equilibrated at 21 ºC for 2 minutes before recording three measurements each of ten runs. Data was collected with automatic attenuation selected and analysed using the Smoluchowski module.




**Supporting Figure 2. Zeta potential measurement for FePt-coated $CPMV_{FePt}$ particles suspended in buffer at pH 7.2.**

## References

[1] J. T. Dessens and G. P. Lomonossoff, *J. Gen. Virol.*,1993, **74**, 889-892.

[2] L. Liu and G. P. Lomonossoff, *J. Virol. Meth.*, 2002, **105**, 343-348.

[3] J. Wellink, *Methods Mol. Biol.*, 1998, **81**, 205-209.

[4] N. F. Steinmetz, G. P. Lomonossoff and D. J. Evans, *Langmuir,* 2006, **22**, 3488-3490.