Synthesis of Platinum Nanowheels Using a Bicellar Template

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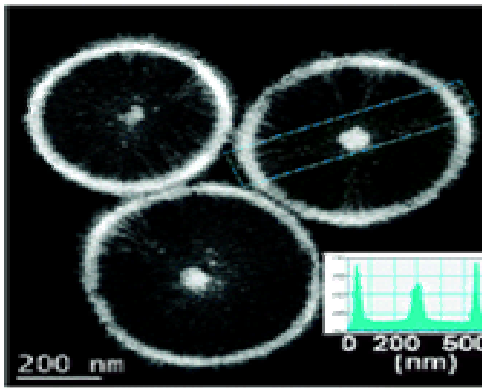

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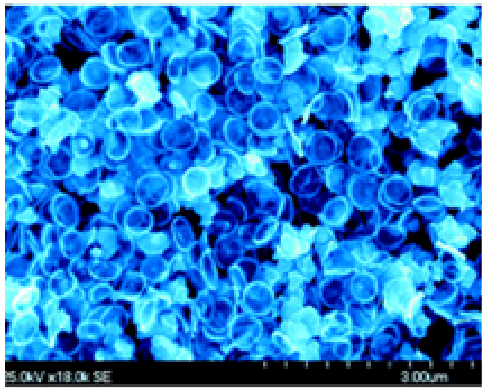

DOI: 10.1021/ja8047464

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06-09-2008

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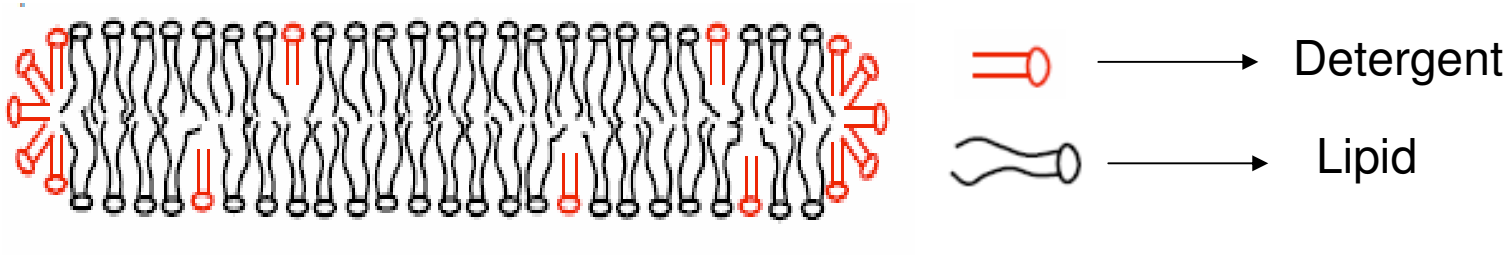
Introduction

- Bicelles (bilayered micelles) are aqueous lipid–detergent assemblies in which discrete bilayer fragments are edge-stabilized by certain detergents.

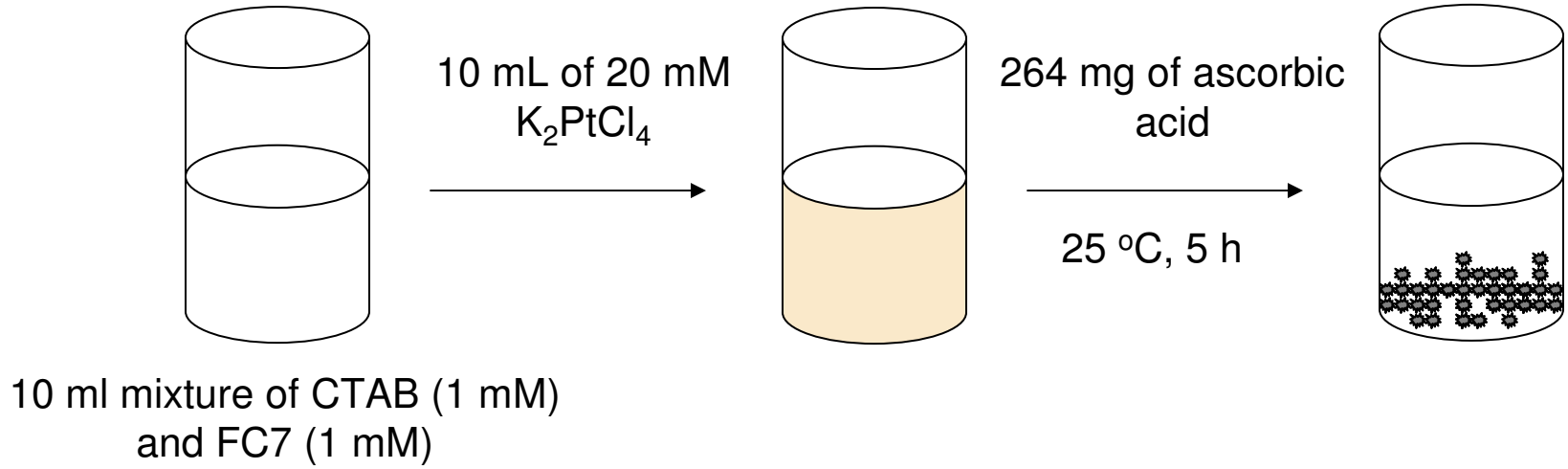


- They are biomimetic membrane models.
- Bicelles are magnetically orientable and exhibit liquid crystalline property.
- Bicelles – As a soft template for the synthesis of nanomaterials.

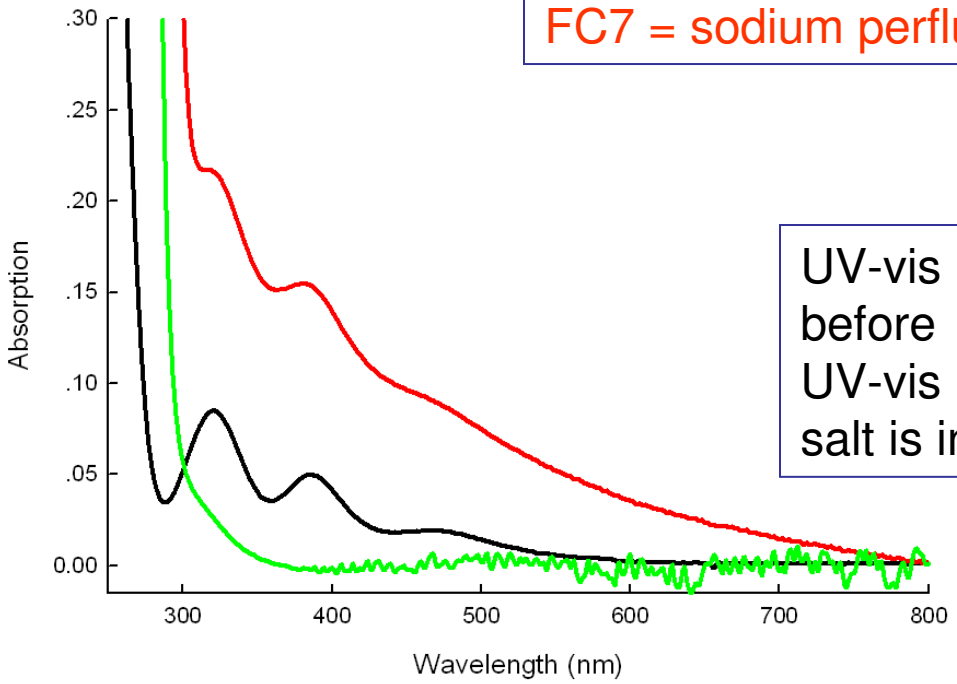
About the paper …

Synthesis of nanowheels and nanodiscs of Platinum using bicelles as template.

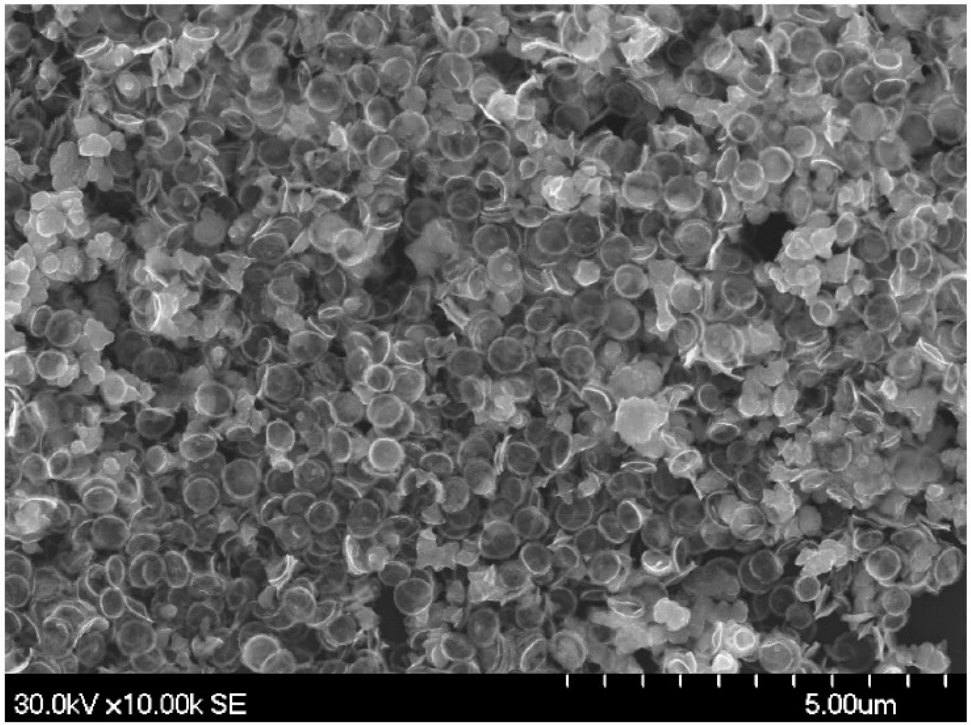
Experimental procedure



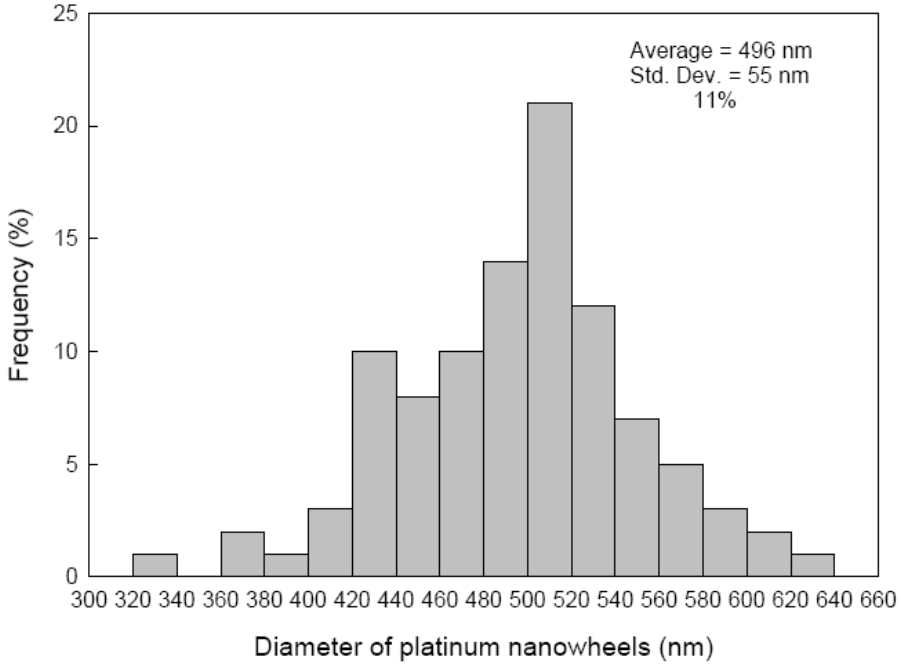
FC7 = sodium perfluorooctanoate



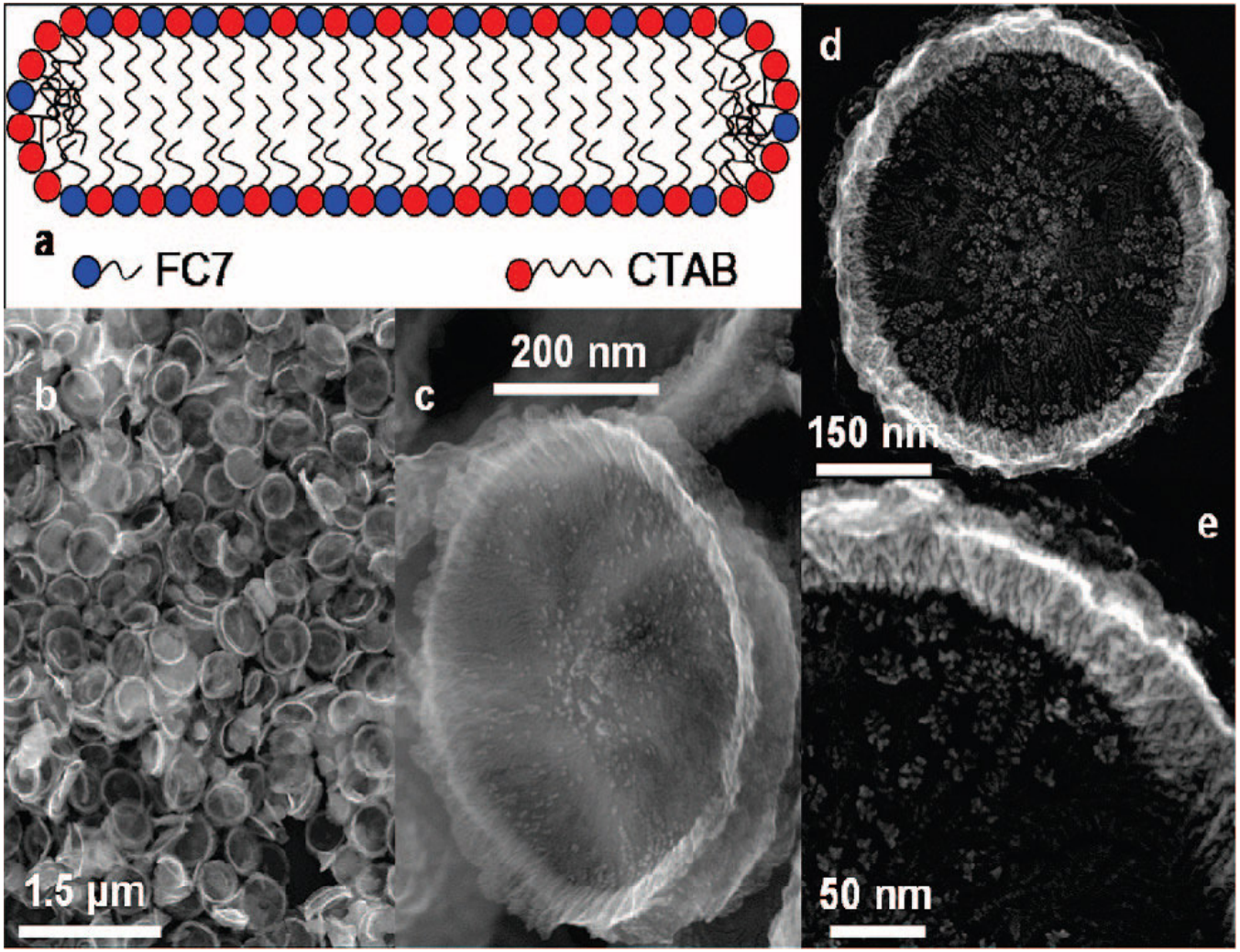
UV-vis spectrum of a reaction system before (red) and after reaction (green). UV-vis spectrum of aqueous platinum salt is included (blue).



SEM image of platinum nanowheels. Reaction conditions: 10 mM Pt(II), 0.5 mM of CTAB and FC7, and 75 mM AA in 20 mL of water at 25 ºC

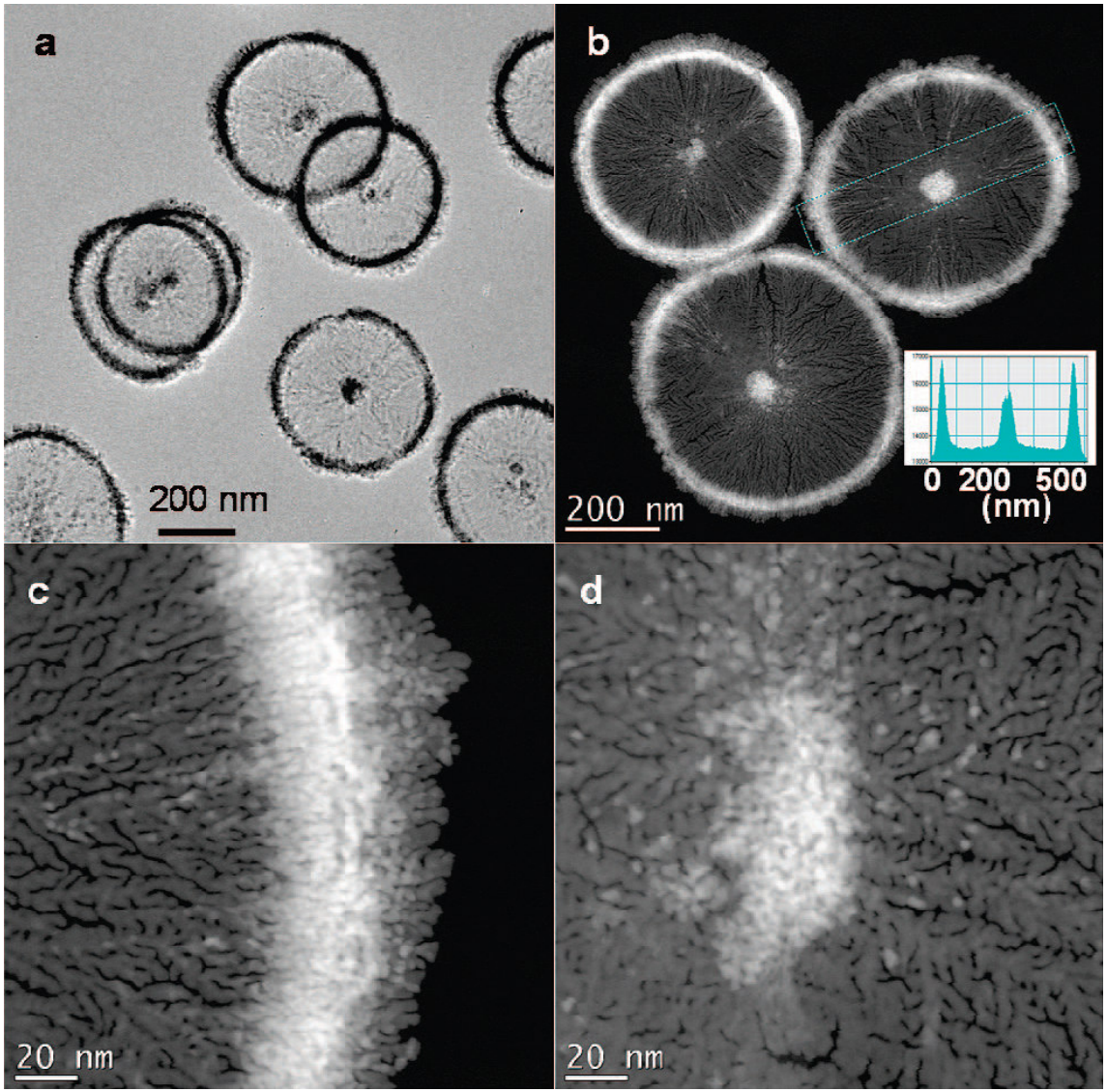


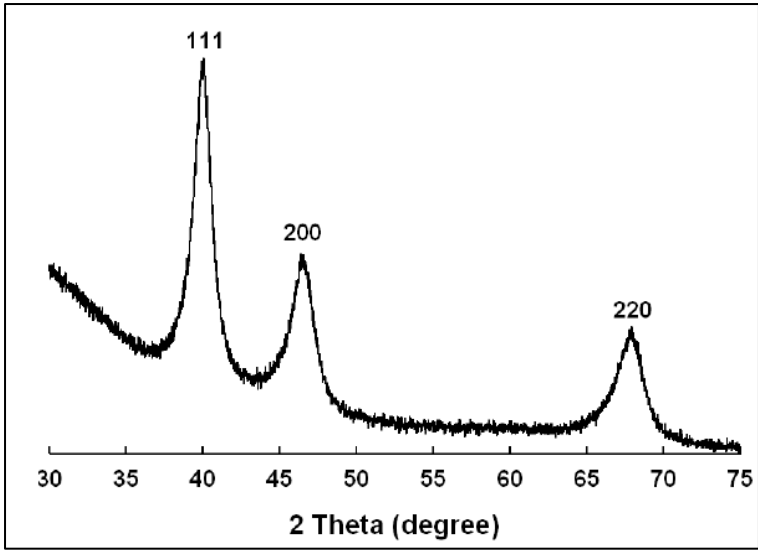
Plot of frequency versus diameter for 100 randomly selected platinum nanowheels.



❖Flaring at the edge that gives the wheel-like morphology.

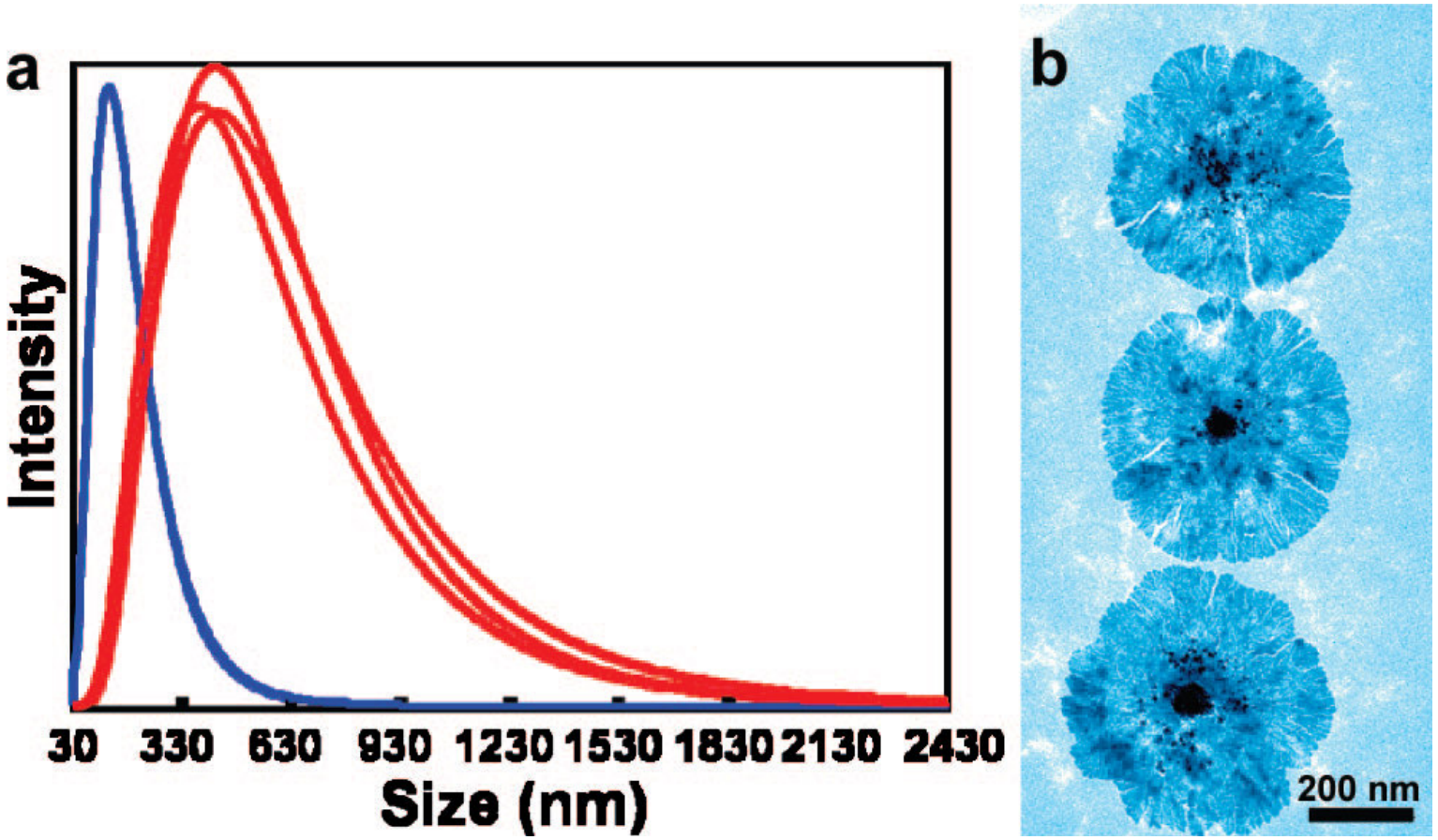
a) Illustration of the cross-sectional view of a bicelle composed of two different surfactants, CTAB and FC7 in the present system. (b-e) SEM images of platinum nanowheels at different magnifications.



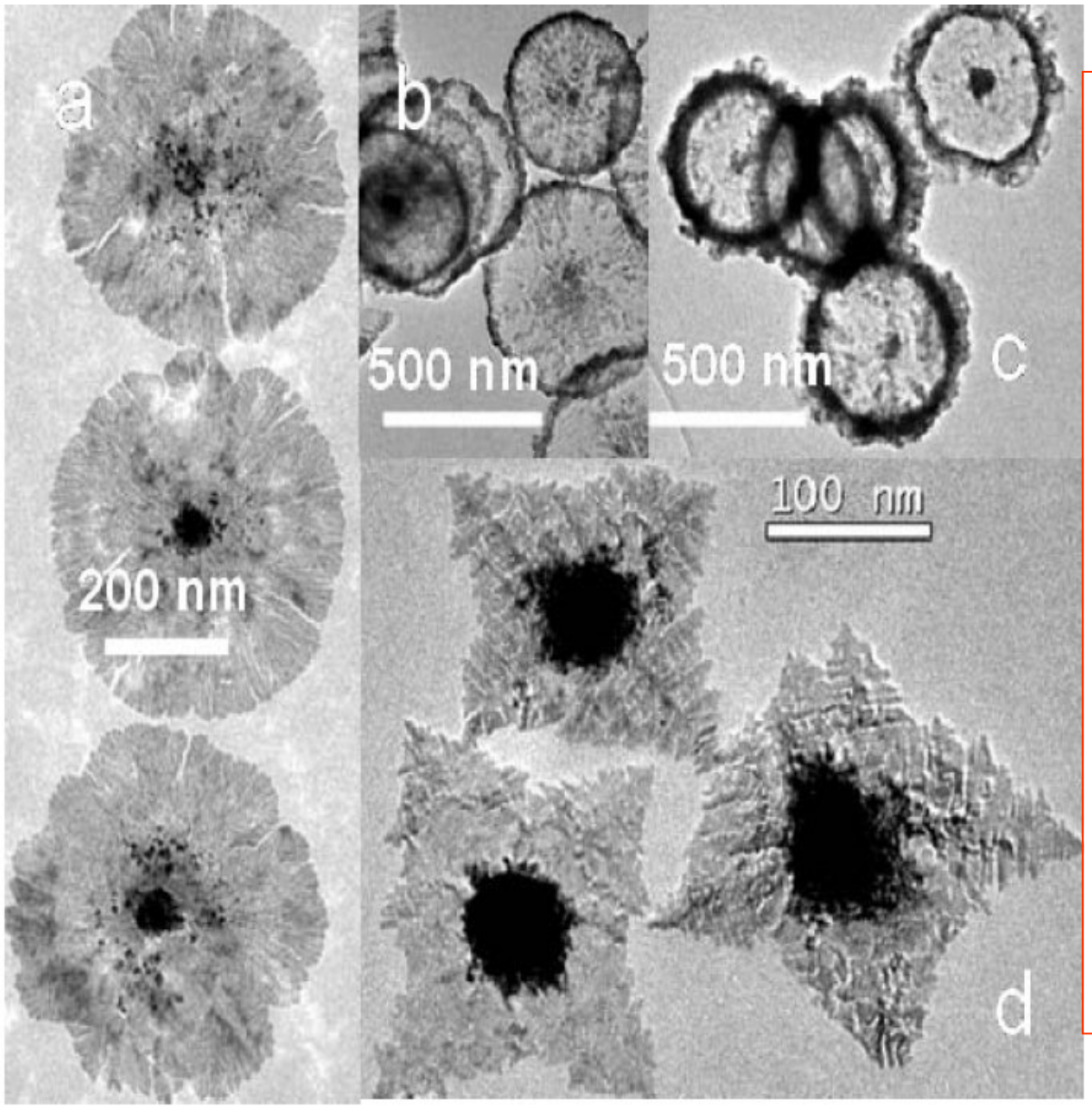


X-ray diffraction pattern of the platinum nanowheels

TEM (a) and STEM (b-d) image of platinum nanowheels (Inset: platinum density profile crossing selected region of a wheel in (b)).



(a) DLS (Dynamic light scattering) size distributions of bicelles in stock suspension containing 1 mM of CTAB and FC7 (blue), and three repetitions for the reaction system containing bicelles, Pt(II) salt, and AA (0.5 mM CTAB and FC7, 10 mM K_2PtCl_4, and 150 mM AA (red)). (b) TEM image of platinum nanodisks.



(a) 5 mM Pt(II), 0.5-mM CTAB and FC7, 75-mM AA, 25ºC;

(b) 10-mM Pt(II), 0.5-mM CTAB and FC7, 75-mM AA, 20 ºC;

(c) 10-mM Pt(II), 0.5-mM CTAB and FC7, 75-mM AA, 30 ºC;

(d) 10-mM Pt(II), 2.5 mM of CTAB and FC7, 75-mM AA, 25ºC. The rectangular structure in (d) suggests a new templating surfactant phase or a change in the metal growth morphology under these growth conditions.

TEM images of platinum nanostructures obtained under different reaction conditions.

Conclusions

- The nanowheels and nanodiscs of Platinum are successfully synthesized using bicelles as template.

- The structural features of the platinum wheels arise from confined growth of platinum within the bilayer.

- Controllability of the synthesis is demonstrated by varying the reaction parameters including metal salt concentration, temperature, and total surfactant concentration.

- This study opens up opportunities for the use of other inhomogeneous soft templates for synthesizing metals, metal alloys, and possibly semiconductors with complex nanostructures.

Thanks