PROCORE - FRANCE/HONG KONG JOINT RESEARCH SCHEME
COMPLETION REPORT

Project Reference Number

F-HK22/10T

Project Title

Novel Nanostructure Engineering by Self-Assembly of Amphiphilic Hollow Particles: Synthesis, Characterization and Fundamental Study

Particulars

	Hong Kong team	French team
Name of Project Co-ordinator (with title)	English: Prof. Pei Li Chinese: 李蓓	Prof. Redouane Borsali
Name of Co-Investigator (if any)	English: Chinese:	
Institution or Institutional affiliation	[ ] CityU [ ] HKU [ ] CUHK [ ] HKUST [ ] HKBU [ ] LU [ ] HKIEd [x] PolyU	[ ] CEA [ ] INRA [x] CNRS No. [ ] INRIA [ ] INFREMER [ ] INSERM No. [ ] University of [ ] Others:
Other project team members (if any)		Dr. Issei OTSUKA

Funding Period

	1st year	2nd year (if applicable)
Start Date	01 Jan. 2011	01 Jan. 2012
Completion Date	31 Dec. 2011	31 Dec. 2012

Objective(s) as per original application

1. Synthesis and characterization of (i) PEI-*g*-PMMA and (ii) polysaccharides-g-PMMA hollow particles with different chain architectures
2. Creation of novel nanostructured materials through manipulation of assembling conditions using preformed hollow particles as building blocks
3. Creation of hierarchical structures via manipulation of assembling conditions using preformed nanotubes as building blocks
4. Characterization of assembled nanostructures using various advance instruments and study of their formation principles

[Please attach relevant document(s)]

i) Outline of proposed research and results obtained

1. Synthesis and characterization of PEI-g-PMMA and polysaccharide-g-PMMA hollow particles with different chain architectures

Amphiphilic poly(methyl methacrylate) (PMMA)/polyethyleneimine (PEI) hollow particles have been prepared. Properties of these particles including their surface property, particle size, size distribution, charge density and morphology were carefully studied using various advance characterization techniques. Polysaccharides-based particle system has also been synthesized and studied.

2. *Creation of novel nanostructured materials through manipulation of assembling conditions using preformed hollow particles as building blocks*

Various assembly conditions have been systematically studied. Correlations between morphologies of nanostructure formation and assembling parameters were established. Properties of these assemblies were fully characterized including their surface properties, sizes and morphologies.

3. *Creation of hierarchical structures via manipulation of assembling conditions using preformed nanotubes as building blocks*

Hierarchical structures was constructed using the preformed nanotubes as the building block under various assembling conditions such as pH, assembling time, temperature and electrolyte concentration

4. *Characterization of assembled nanostructures using advance instruments and study of their formation principles*

Above studies were carried out using the state-of- the-art characterization techniques including laser dynamic light scattering, SEM, TEM, Cryo-TEM and AFM and contact angle measurement.

ii) Significance of research results

1. Intriguing hierarchical structures including nanotubular bundle, columnar, reticular plate-like and highly packed interwoven plate-like materials have been created through self-assembling the amphiphilic core-shell nanotubes in water under various pHs.

2. A new type of invertible hollow polymer (IHP) particle was synthesized. The resulting IHP particles can be stably dispersed in both non-polar solvent and water. We have investigated the morphology and surface property of the particles in both dichloromethane (DCM) and water using transmission electron microscopy, water contact angle measurement, and X-ray photoelectron spectroscopy analysis to gain insight into this unique particle dispersibility. Sustainability of the solvent-invertible property was carefully studied through repeated treatment of the IHP particles in DCM or water for up to six cycles. Solvent-dependant property of the dry films formed by IHP particles was also investigated through water contact angle measurement. Our results demonstrate that the amphiphilic hollow particles are a new type of polymer design for smart materials that are invertible in response to non-polar and aqueous media in both dispersed and solid states.

3. Synthesis of polysaccharide-based core-shell and hollow particles has been attempted. The xyloglucan was first chemically modified, followed by the graft polymerization to form core-shell particles containing polymer core and xyloglucan core. Preliminary results suggest that our designed route is a feasible approach to prepare sugar-based nanomaterials which will find many potential applications.

iii) Research output

1. Cheng Hao Lee, Chun Him Wong, Djamila Ouhab, Redouane Borsali, Pei Li, "*Synthesis and Characterization of Solvent-Invertible Amphiphilic Hollow Particles*" **Langmuir**, In press (2013), DOI: 10.1021/la401399m.

2. Cheng Hao Lee, Chun Him Wong, Djamila Ouhab, Redouane Borsali, Pei Li, "*Solvent-Invertible Amphiphilic Hollow Particles: Synthesis and Characterization*" **2013 International Polymer Colloid Group Conference**, Shanghai, China, June 23-28, 2013.

iv) Potential for or impact on further research collaboration

Further to our exchange programme and collaborative research in this scheme, we intend to apply for The French National Research Agency (ANR)/Research Grants Council (RGC) Joint Research Scheme in 2014 in order to establish a long term collaborative research.