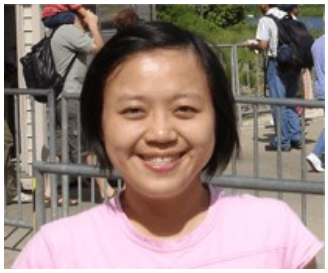
# Katie Liu



**Katie M Liu**

School of Chemical Engineering

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PhD student

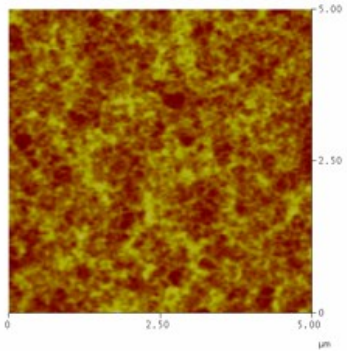
Project Title: “Understanding mechanical properties of microcapsules and their adhesion on fabric fibres”

Katie graduated from The University of Birmingham in 2004 with a Master of Engineering Degree (First class honours) in Chemical Engineering with Management. She worked at the Singapore Shell Refinery as an intern in 2000 where she had gained valuable experience in process troubleshooting and problem solving. She had also worked in the pharmaceutical industry in Beacons Chemical, Singapore in 2001. She had also worked as a Process Engineer in PCB manufacturer Pentex and Process & Equipment Engineer in TECH Semiconductor, Singapore from 2004 to 2005.

Katie started her PhD project at Birmingham in 2006 which is funded by Department of Chemical Engineering and Proctor & Gamble UK. The title of her PhD project is “Understanding mechanical properties of microcapsules and their adhesion on fabric fibres”. Microcapsules have been widely used in a multitude of industrial fields, ranging from pharmaceuticals, biomedical, agriculture, food and personal care products to photography and printing. There is a growing need to deliver the “active molecules” from the core of microcapsules to the surface of fabric surface in personal care products. For such applications, these microcapsules are required to remain intact during preparation processes, whilst being able to adhere to fabric surface and subsequently rupture under a given mechanical load in order to release the encapsulated active ingredient.

The aim of the project is to study the mechanical properties of melamine formaldehyde (MF) microcapsules using a well established micromanipulation technique. The microcapsules with diameter range of 10-50 m were produced by in-situ polymerization. The effects of formulation and processing conditions on the mechanical strength of MF microcapsules with a potential application to deliver an oil based active ingredient to a fabric surface were investigated. Appropriate modeling was applied to the experimental data to determine the Young’s modulus of microcapsule wall. Transmission Electron Microscopy (TEM) was also applied to determine the wall thickness of microcapsules and its uniformity. The results obtained aid the formulation of microcapsules with desirable mechanical properties.

The adhesion between MF microcapsules and fabrics in air as well as in the liquid media relevant to industrial applications was also investigated. A thin and uniform cotton cellulose film was generated by dissolving cotton powder in NMMO (N-methylmorpholine-N-oxide) solution; as a result, the geometry of interaction and the surface roughness of cotton film could be better controlled for use in adhesion measurements. Spectroscopic Ellipsometry, Atomic Force Microscopy (AFM), X-ray Photoelectron Spectroscopy (XPS) and contact angle measurement techniques were employed to characterize the cotton films. The AFM image of regenerated cotton film is shown here.




AFM technique was also applied to measure the adhesive force between MF microcapsules and the regenerated cellulose film in air and in various liquid media with different concentrations and pH values. Moreover, the mechanisms of adhesion involved in the systems were investigated and discussed. The results obtained will help to maximize the adhesion of MF microcapsules to fabric surfaces, and the delivery of the “active ingredients” to the intended target can be realized efficiently and effectively.

Katie enjoys singing and playing the keyboard very much; she was member of University Choir (2003-2004) and performed twice at Birmingham Symphony Hall. She also takes pleasure in hiking, playing golf and yoga in her spare time.

**Awards**

- Runner up prize on poster competition at College Research Conference of The University of Birmingham (2008)
- Messel Bursary from Society of Chemical Industries (2008)
- Outstanding presentation and poster in Proctor & Gamble Super Sharer Award (2006)

**Affiliations**

Associate Member of Institute of Chemical Engineers
Member of Society of Chemistry and Industries

**Publications**

1.Liu, K.M., Preece, J., York, D., Bowen, J., Zhang, Z., 2008, Understanding Adhesion of Microcapsules on Fabric Surface, Proceedings of 9th UK Particle Technology Forum.
2.. Liu, K.M., Preece, J., York, D., Zhang, Z., 2007, Understanding Mechanical Properties of Microcapsules, Proceedings of 8th UK Particle Technology Forum.
3.. Ingram, A., Chung, K.H.K., Liu, K.M., Wood, J., Seville, J.P.K., 2005, Particle tracking to investigate flow behavior in a novel rotary gas/solid contactor, Proceeding of 7th World Congress of Chemical Engineering, C7-008.



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