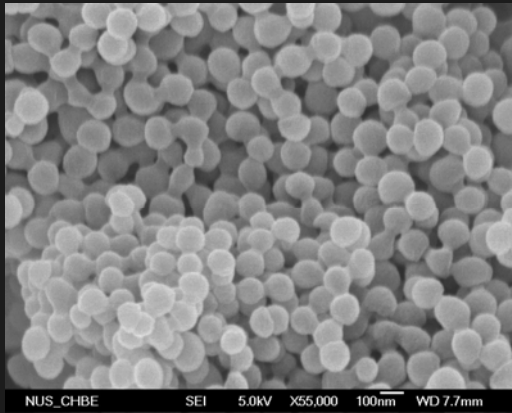


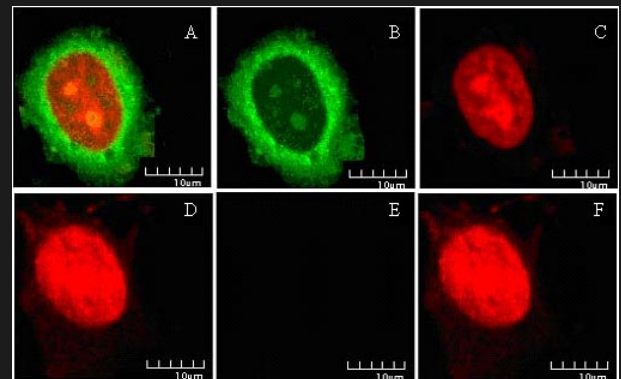
Chemotherapeutic Engineering – Application and further development of chemical engineering principles to solve problems in chemotherapy of cancer and other diseases such as cardiovascular restenosis and AIDS.



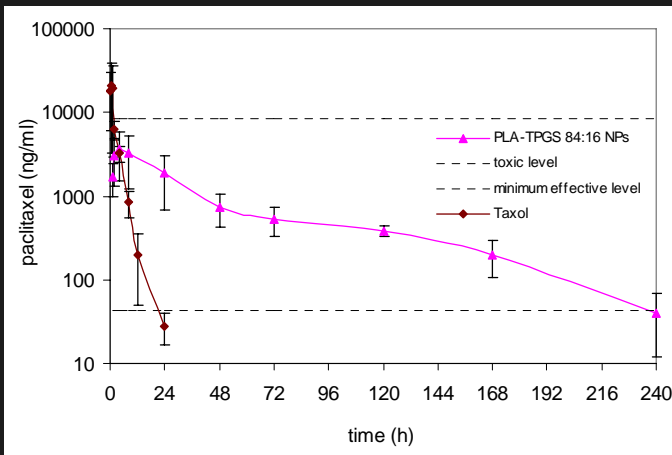
FESEM image of paclitaxel-loaded PLA-Tween 80-20 nanoparticles.

Cancer is a leading cause of deaths and has become the #1 killer in many countries including Singapore. No substantial progress can be observed in the past 50 years in fighting cancer. The cancer death rate in US was 1.939‰ of the total population in 1950 and still 1.940‰ in 2001, 1.934‰ in 2002 and 1.901‰ in 2003. Nanomedicine/Cancer Nanotechnology/ Chemotherapeutic Engineering will radically change the very foundations of diagnosis, treatment and prevention of various fatal diseases including cancer. The current regimen of chemotherapy is far from being satisfactory. Its efficacy is limited and patients have to suffer from severe side effects. We are conducting a full spectrum of proof-of-concept research on how nanoparticle technology could provide an ideal solution and with further development, promote a new concept of chemotherapy, which may include sustained, controlled and targeted chemotherapy; personalized chemotherapy; chemotherapy across various physiological drug barriers; and eventually, chemotherapy at home.

Vitamin E TPGS coated poly(lactic-co-glycolic acid) (PLGA) nanoparticles and poly(lactic acid)-vitamin E TPGS (PLA-TPGS) copolymer nanoparticles are developed to formulate paclitaxel as model drug, which are characterized by various techniques for size and size distribution, surface morphology, surface chemistry, and surface charge. Drug encapsulation efficiency and *in vitro* drug release profile were measured. *In vitro* cancer cell viability experiment demonstrated that the paclitaxel formulated in nanoparticles could be 46 times more effective than Taxol® after 24 hours of treatment. *In vivo* pharmacokinetics showed that the drug formulated in PLA-TPGS nanoparticles could achieve 3.9 times higher therapeutic effects and 23.0 times longer half-life than Taxol®. One shot can realize sustainable chemotherapy of 336 hours compared with 22 hours for Taxol®. Xenograft tumor model confirmed the advantages of the nanoparticle formulation versus Taxol®.



Confocal Images of MCF-7 cancer cells incubated with (upper row) coumarin-6-loaded, TPGS-emulsified PLGA nanoparticles or (lower row) TPGS-emulsified PLGA nanoparticles as control for 2 hr at 37°C.



Plasma concentration-time profiles of paclitaxel formulated in Taxol® (10 mg/kg) or PLA-TPGS copolymer nanoparticles prepared by the dialysis method after *i.v.* administration to SD rats (n=4).

Research tracks:

- NPs for anticancer drug formulation
- NPs for cardiovascular tissue repair
- NPs for gene therapy
- NPs for molecular imaging
- NPs for oral chemotherapy
- Multifunctional NPs
- Interactions between NPs & biological cells

References:

- [1] Feng SS. *Nanomedicine*, 1(3): 297-309, 2006.
- [2] Feng SS. *Expert Review of Medical Devices*, 1(1):89-99, 2004.
- [3] Feng SS, Chien S. *Chemical Engineering Science*, 58:4087-4114, 2003

Patents:

- [1] US11/342,662: Nanoparticle coating for drug delivery.
- [2] US11/342,663: Nanoparticle-Based Drug Delivery System.