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$Fe_{3-\delta}O_4$ nanoparticles inspired clinical therapeutics in cancer and *Clostridium difficile* infection

Dar-Bin Shieh[1], Pei-Jane Tsai[1], Wei-Ting Lee[1], Chen-Sheng Yeh[1], Shang-Rung Wu[1] and **Benjamin Tsang[2]**
[1]National Cheng Kung University, Taiwan
[2]Ottawa Hospital Research Institute, Canada

Clostridium difficile infection (CDI) and cancer both are important causes of global healthcare cahllenges. Resistance of CD spores as well as cancer cells to various therapeutic measures post a significant threat. Nanomaterials have been explored for applications in anti-microbials as well as cancer therapy with intrinsic advantages of low drug-resistance issues and high efficacy. We discovered the 22 nm octahedral $Fe_{3-\delta}O_4$ single crystal nanoparticles with a strong saturation magnetization (94 emu/g) and exhibited inhibitory effect to CD spore germination *in vitro* and *in vivo* while at the same time serve as an excellent convertor for RF induced nano-heater for cancer hyperthermia therapy. The nanocrystal presented excellent MRI contrast effect and showed a dose dependent inhibition of CD spores germination (62% growth inhibition at 500 μg/mL) close to that of sodium hypochlorite. CDI animal model established in NF-κB-reporter mice presented significant bowel inflammation in the MOCK compared to $Fe_{3-\delta}O_4$ nanoparticles treated group as revealed by *in vivo* imaging system. Pro-inflammatory cytokines including IL-1β, TNF-α, and INF-γ and inflammatory cell infiltrations were significantly suppressed after nanoparticle treatment. In addition, the $Fe_{3-\delta}O_4$ nanoparticles (500 μg/mL) did not alter the microbiota and induce the liver or kidney damage *in vivo*. On the other hand, we observed significant anti-cancer efficacy upon integration of RF-hypertehrmia with synchronized thermal responsive chemotherapy in both *in vitro* and *in vivo* with complete tumor remission achieved with targeting add-on. These results provide nano-material based strategy for infection and cancer therapeutics that encourage further clinical translational development.

Biography

Dar-Bin Shieh holds the title of Distinguished Professor, Institute of Oral Medicine, College of Medicine, and National Cheng Kung University (NCKU). His research interests include nanomedicine, oral diagnosis and pathology, molecular biology, cancer biology, cryo-EM, mitochondria. He is a recipient of many major awards, including, the Nano Elite Award, Ministry of Economics, Taiwan and the Outstanding Research Award of Taiwan National Science Council. He holds a numbers of international patents, including one on nano-carrier, complex of anticancer drug, pharmaceutical composition and complex manufacturing for treating cancer. He and the PI have collaborated since 2012 on the molecular and cellular basis of chemoresistance in ovarian and head- and-neck cancers, and have recently published jointly two seminal papers (*PNAS* and *International Journal of Cancer*).

darbinshieh@gmail.com

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