

# NSF-NRI (#1637535): Design of nanorobotics based on FePd alloy nanohelices for a new diagnosis and treatment of cancer

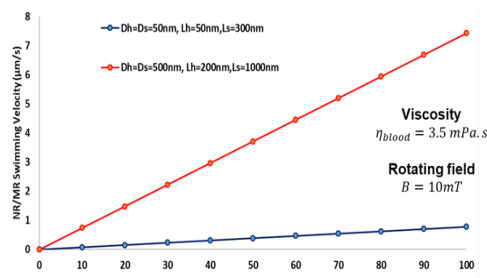
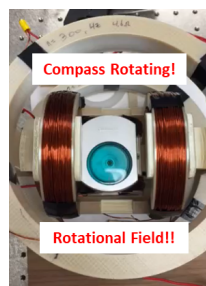


Speaker: Cerwyn Chiew; Principal Investigator: Minoru Taya

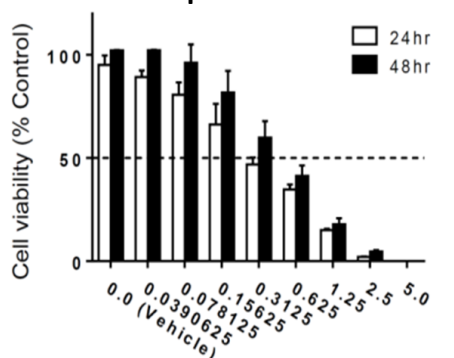


## Advantages

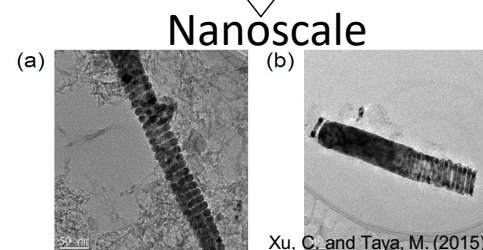
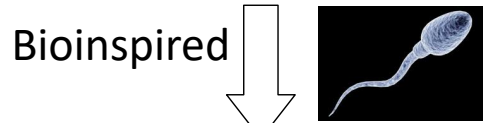
- (1) Flexible helix (shrink/expand)
- (2) Swims thanks to bioinspired nanohelical propeller



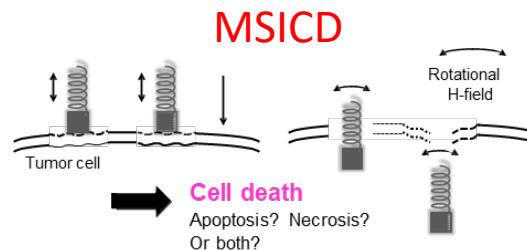
- (3) MRI enhancer (120 emu/g)
- (4) Biocompatible material



Concentration of bare Fe<sub>7</sub>Pd<sub>3</sub> NPs (mg/ml)



Nano-actuator magnetic field

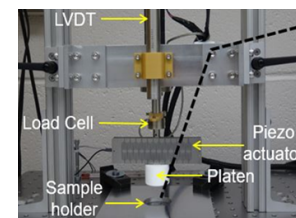


## Challenge

- Nanomanufacturing of nanohelix has very low yield
- Reduced actuation capability of FSMA FePd in nanoscale
- Navigating swimming NRs in situ

## Scientific Impact

- Understanding nanoscale dynamics of FSMA helix
- Deeper Mechanobiology understanding of cancer cells



Study	MSICD Mode	MSICD% vs Equivalent Stress ( $\sigma_{eq}$ )	
Viscoelastic Model	DS (Analytical)	$\sigma_{eq}(t) < \sigma^{ap}$ ( $t < 100s$ )	$\sigma_{eq}(t) > \sigma^{ap}$ ( $210 < t < 300s$ )
Takao et al., (2019)	DS (Experiment)	$\cong 10\%$ apoptosis, $< 75\%$ necrosis ( $t < 100s$ )	$< 1\%$ apoptosis, $< 90\%$ necrosis ( $210 < t < 300s$ )
Tse. J.M., (2011)	QS	No apoptosis reported ( $\sigma^{ap}$ (0.773Kpa) (16Hrs)	Apoptosis reported (16Hrs)

## Broader Impact

- Chemical free/localized cancer treatment
- Overcome Blood Brain Barrier (BBB)
- Coupling with cancer immunotherapy treatment