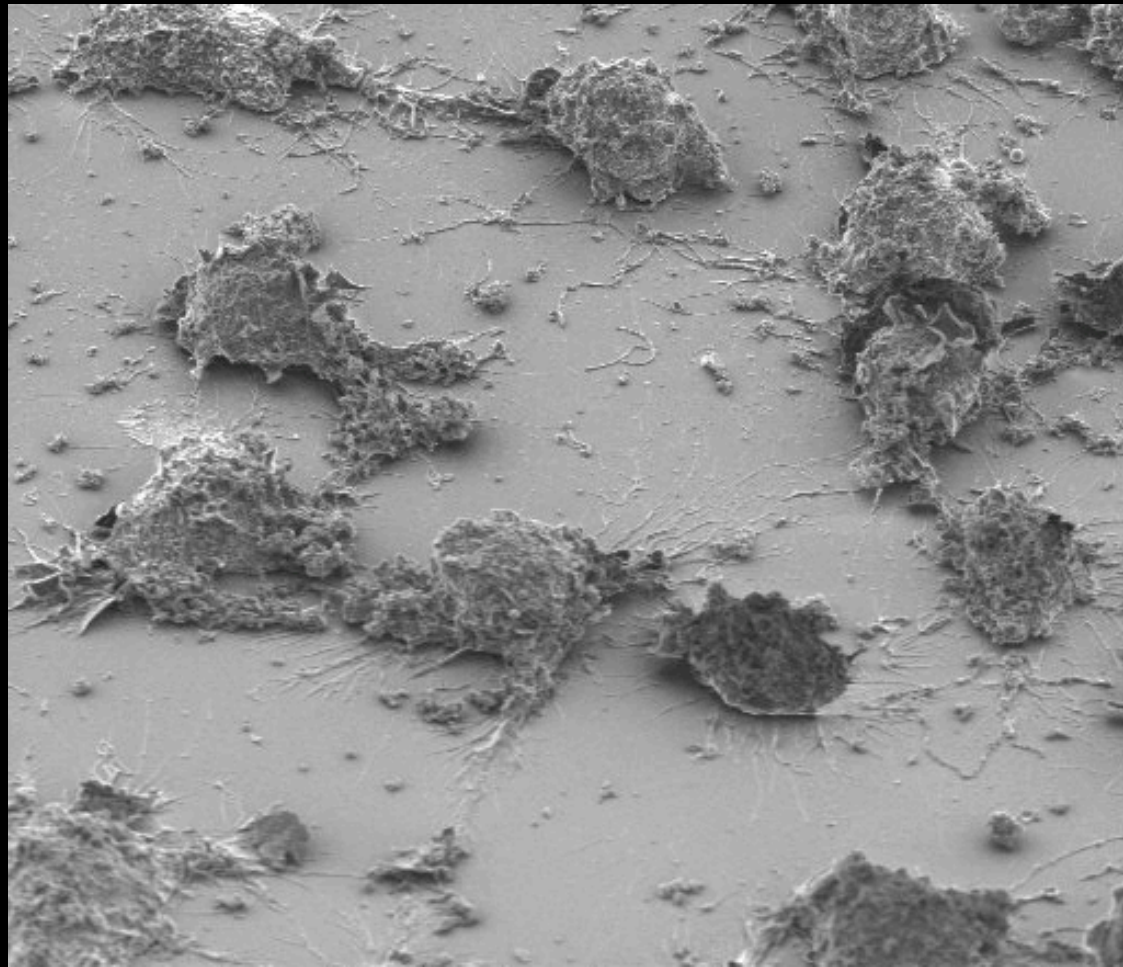


**Vertically
aligned alumina
nanowires
templated by
CNTs as a drug
delivery
platform**



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Jiao Lab

Department of Physics and MME

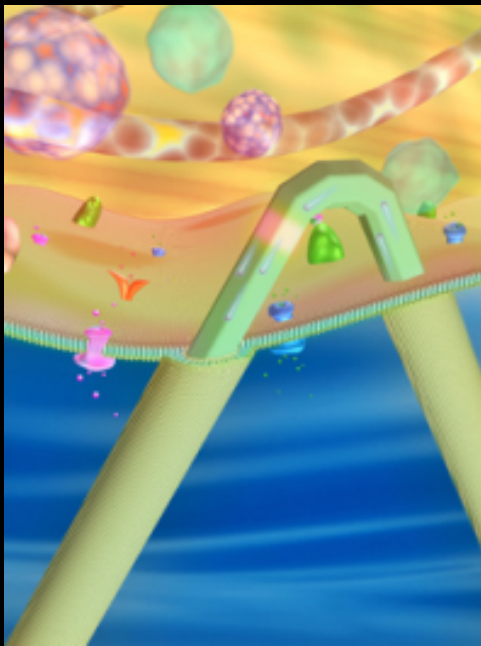
Portland State University

REU 2013

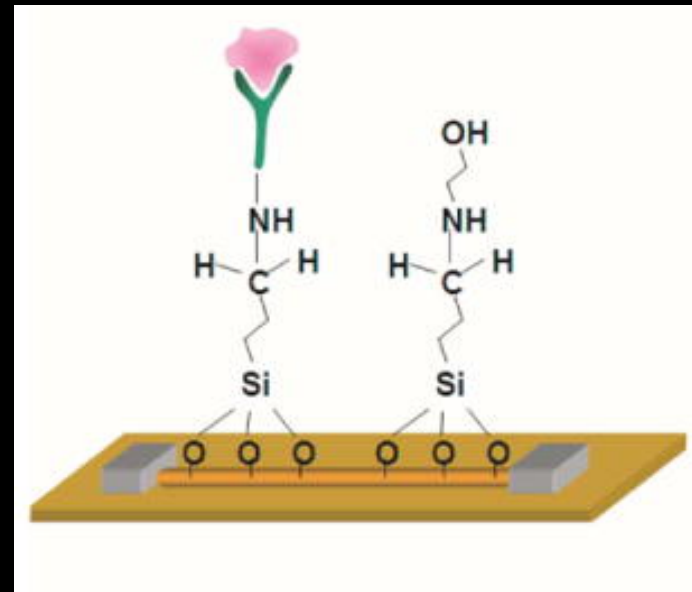
Overview

- Background
- Objectives
- Methods
- Results
- Conclusions
- Ongoing goals

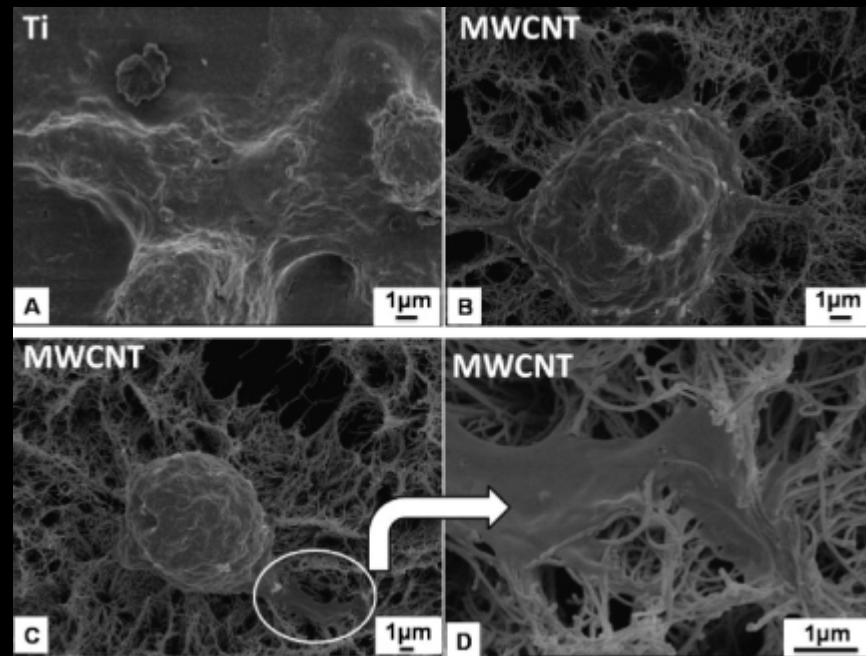
Background



Lieber Group, Harvard

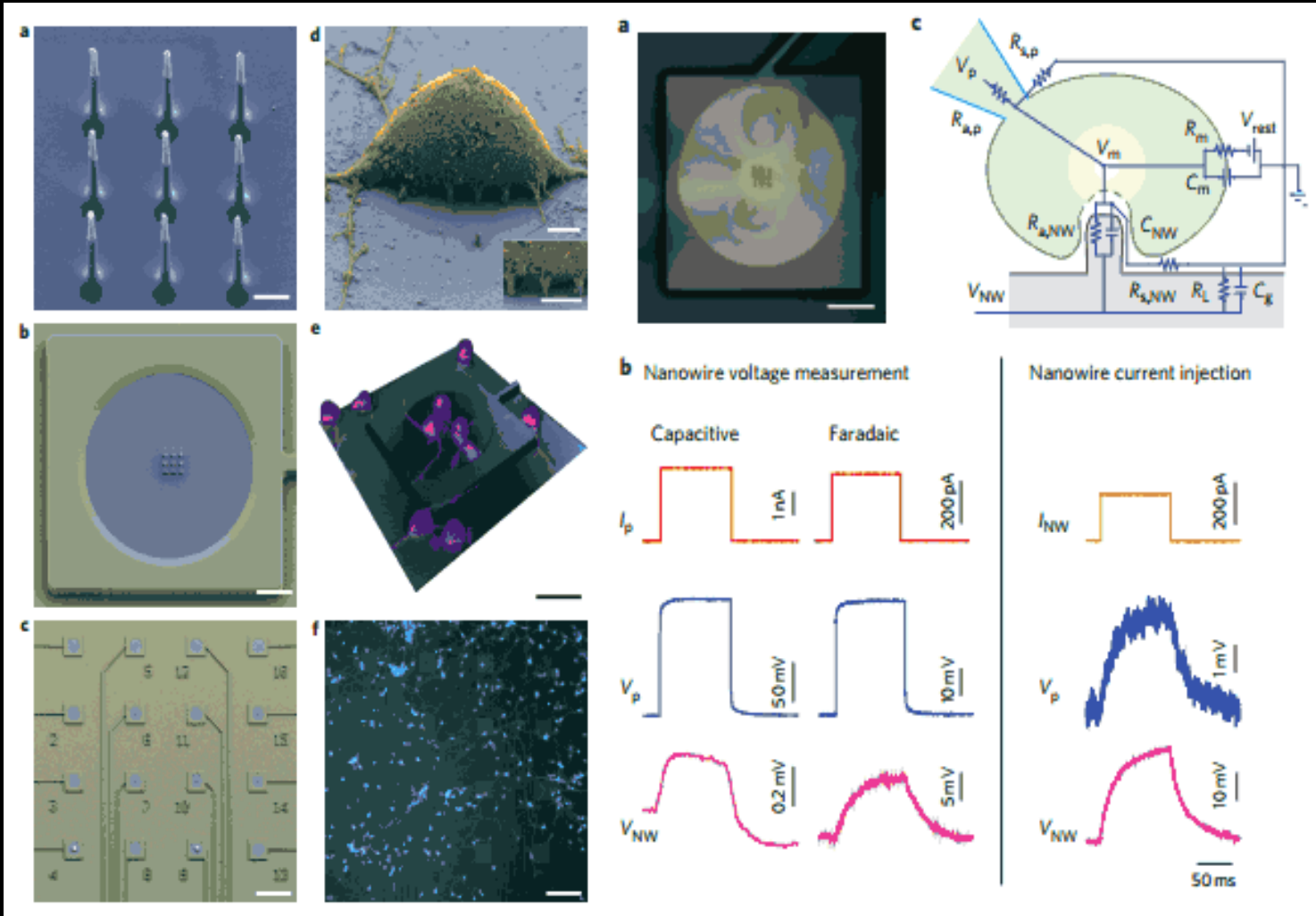


Lieber, Harvard 2011



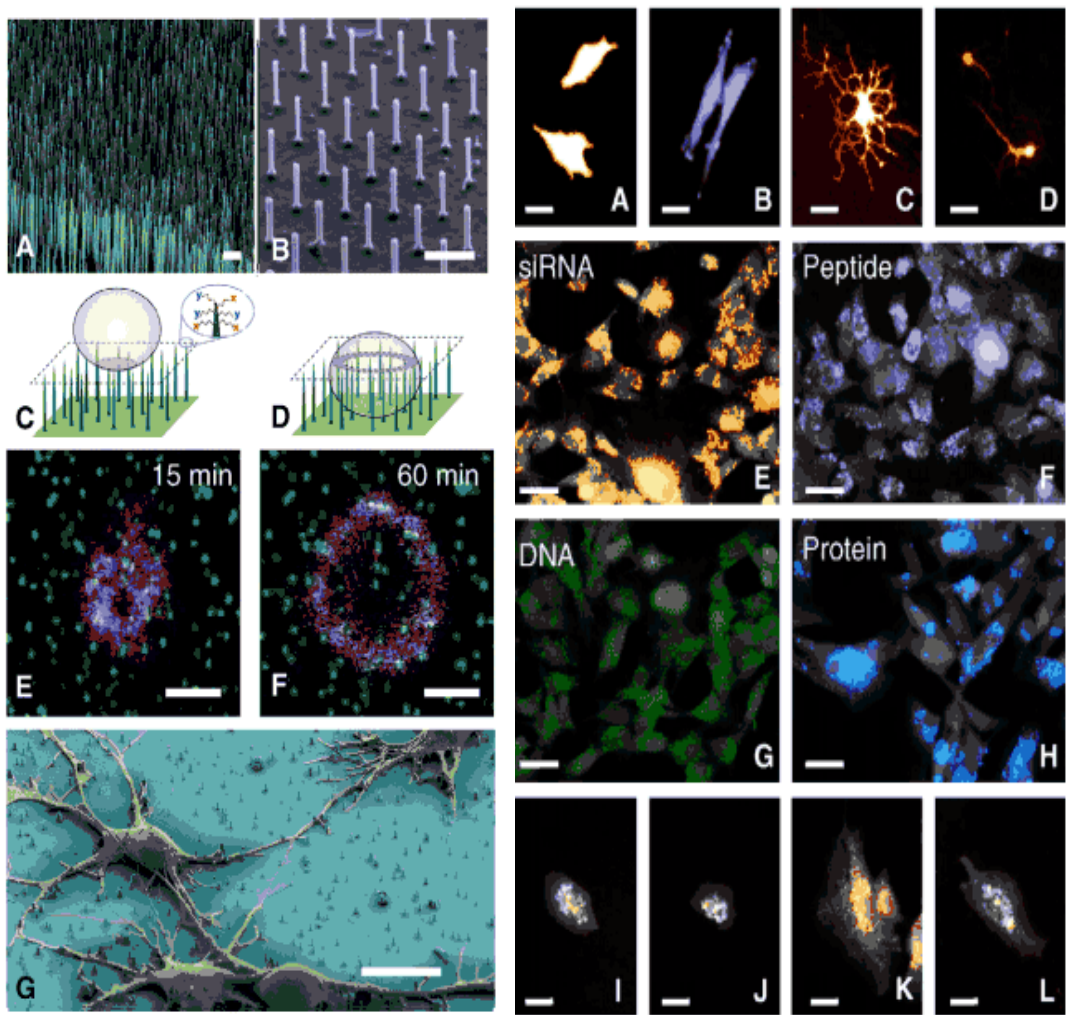
Lobo et al. NanoLetters (2004)

Background

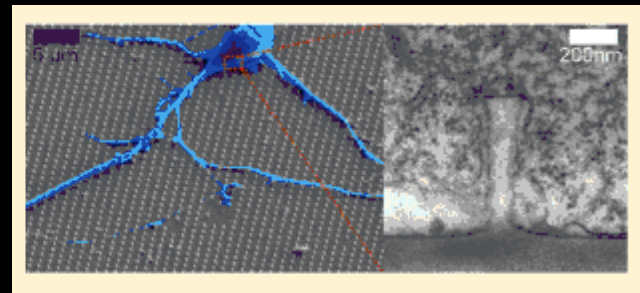


Park Group, Harvard (2012)

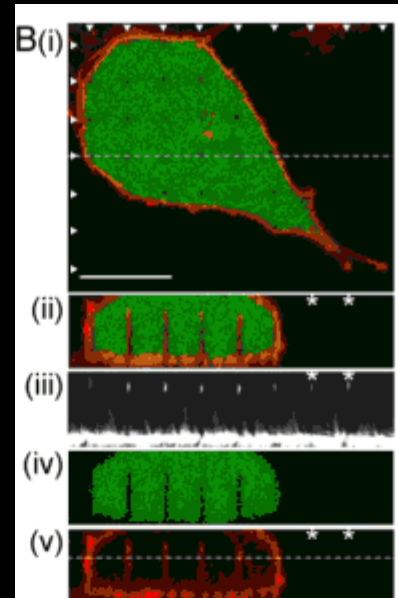
Background



Park, Harvard (2010)



Cui, Stanford (2012)



Martinez Copenhagen (2012)

Background

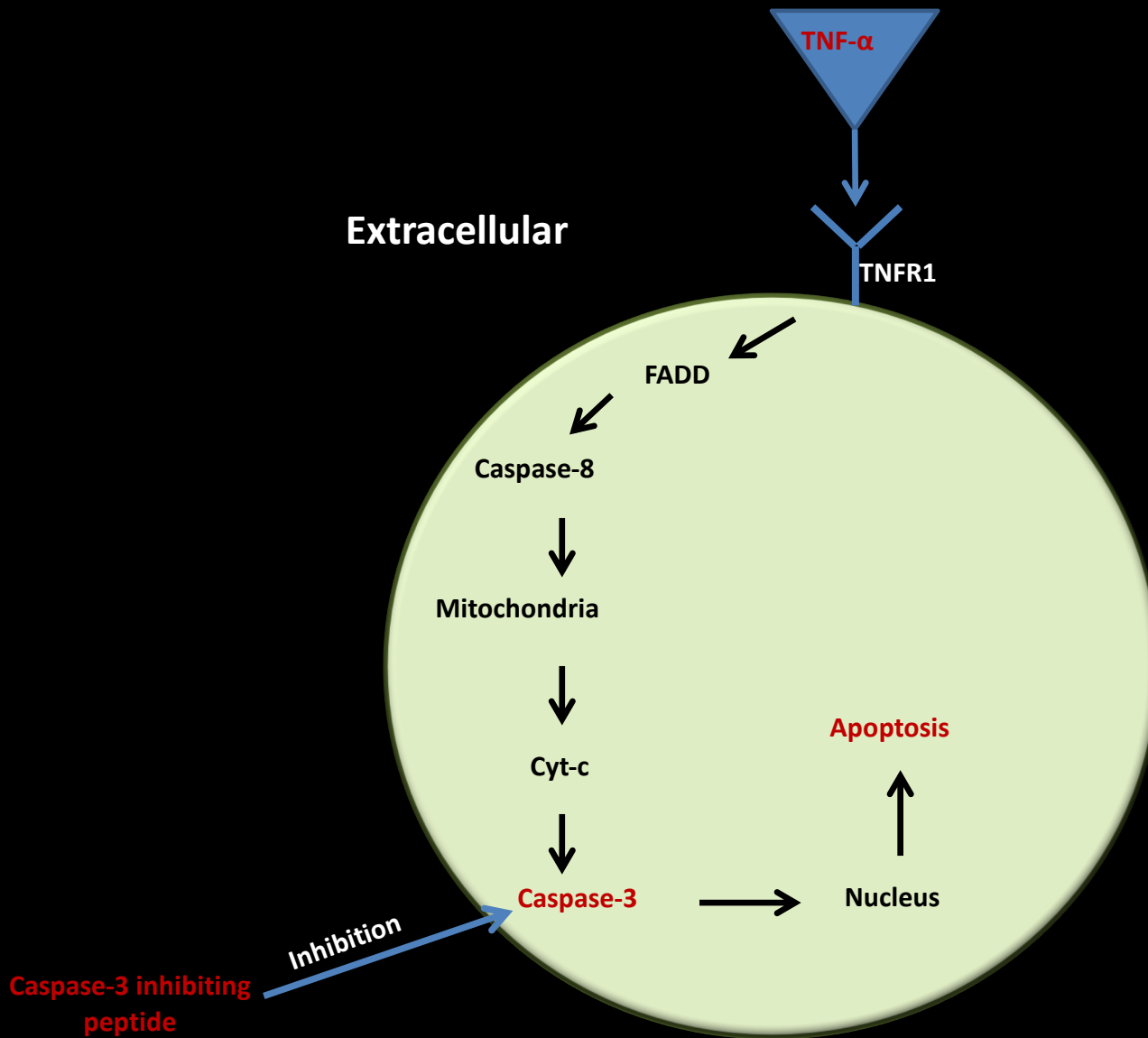
Application/Study	Type of CNT	Biological System	Results	Reference	Functionalization Group	Viability Assay/Time
In vitro, cell interaction	Sieve, interlocking MWCNTs network	L-929	Non-cytotoxic	Correa-Duarte et al.	None	MTT Day 7
In vitro, cell interaction	Dissolved f-SWCNTs	Mouse spleen cells	Non-cytotoxic	Dumortier et al.	PEG	PI ELISA
In vitro, neurite growth/branching	Fixed f-MWCNTs	Rat neurons	Non-cytotoxic	Hu et al.	PABS EN	Calcein hydrolysis
In vitro, cell interaction	VAMWCNTs, horizontal interaction upon culture	L-929	Non-cytotoxic	Lobo et al.	None	MTT LDH Day 7
In vitro, neurite growth/branching	Fixed MWCNTs	Rat neurons	Non-cytotoxic	Mattson et al.	Bare and 4-hydroxynonenal	Neurite Branching
In vitro, cell interaction	Dissolved MWCNTs	HEK	Cytokine IL8 secretion	Monteiro-Riviere et al.	None	Cytokine measurement
In vitro delivery	Dissolved f-SWCNT, WT1Pep427	H-DCs/mice	Immune activation, non-cytotoxic	Villa et al.	Aromatic hydrazine + peptide	Metabolic assay Apoptosis stain ATP assay Day 5
In vitro, cell interaction	Dissolved SWCNT, DWCNT, MWCNT	Mouse osteoblasts	Reduced viability	Zhang et al.	None	MTT ALP Stain of bone nodules

CNT biocompatibility Studies

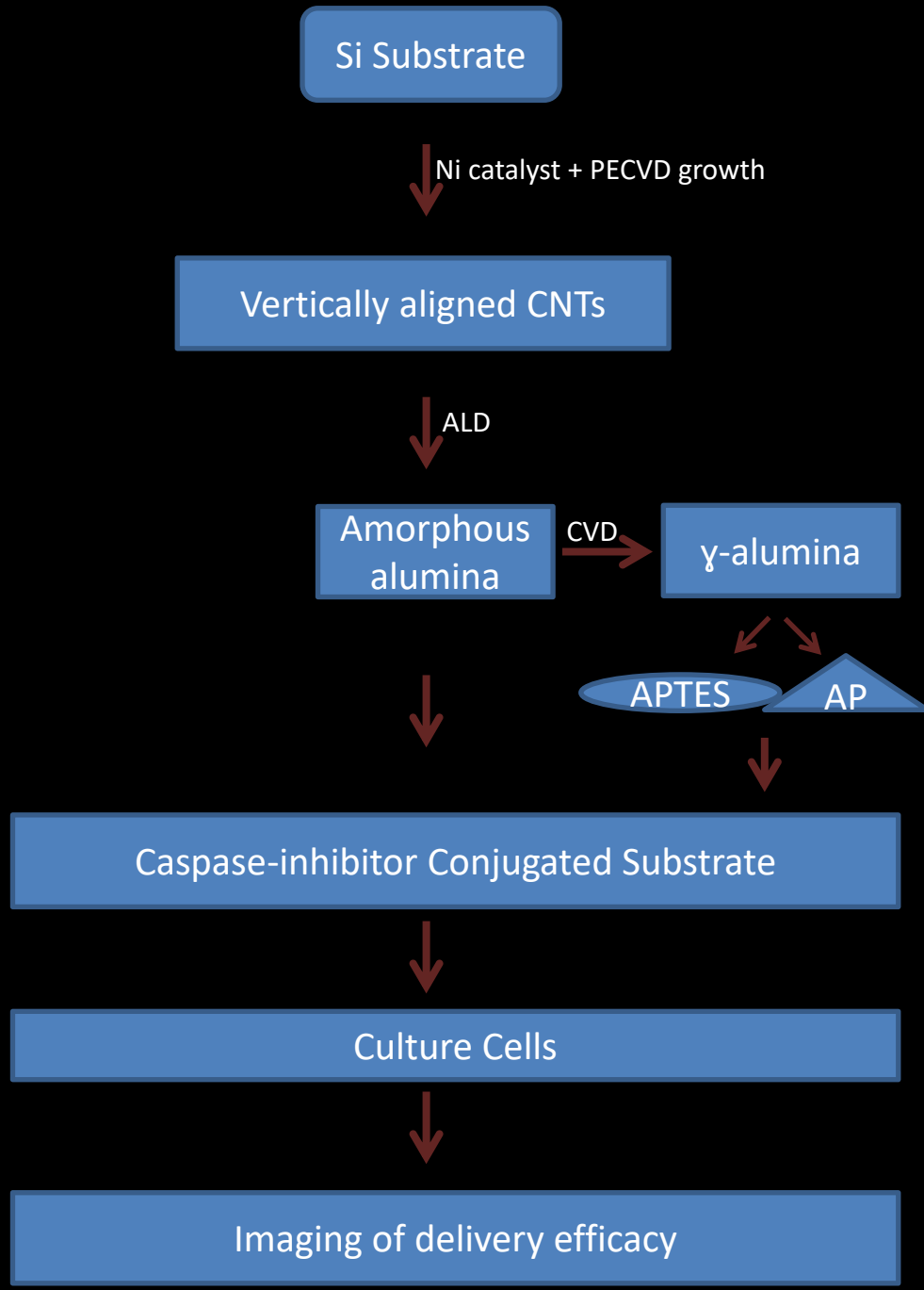
Objectives

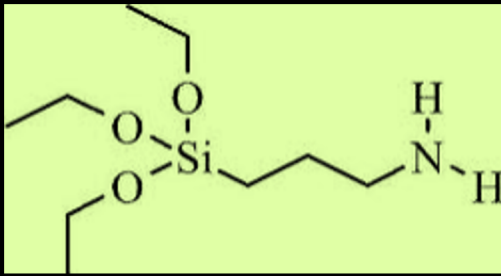
- Investigate CNT-cell interface
 - Delivery efficacy
 - Biocompatibility
 - Enhance interface via Al_2O_3
 - Enhance delivery using chemical linkers

Methods

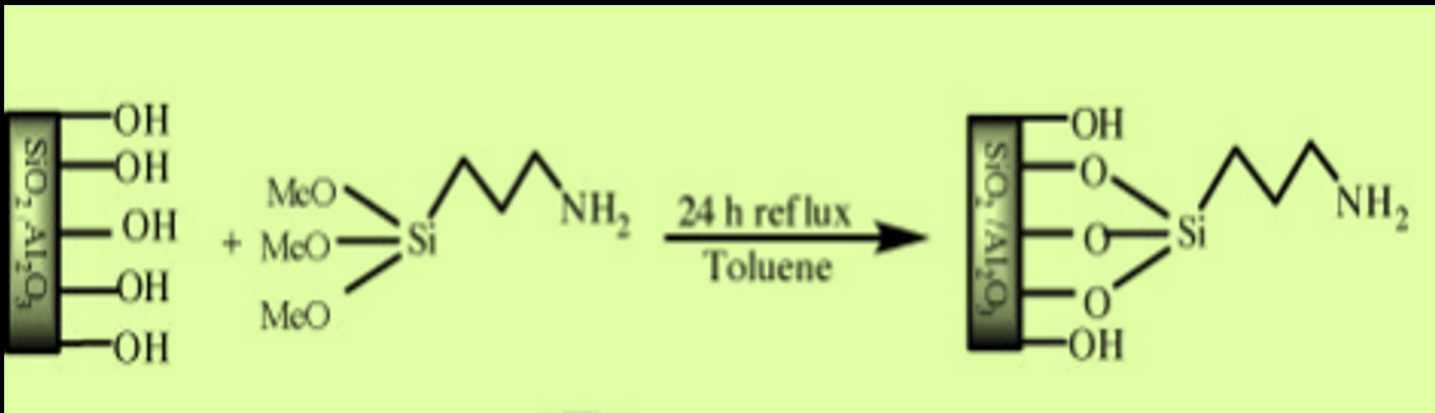


Methods

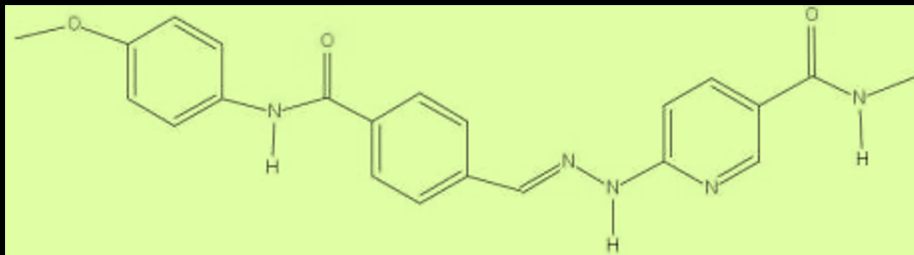




APTES



Habibi et al.



Aminophenol

Results

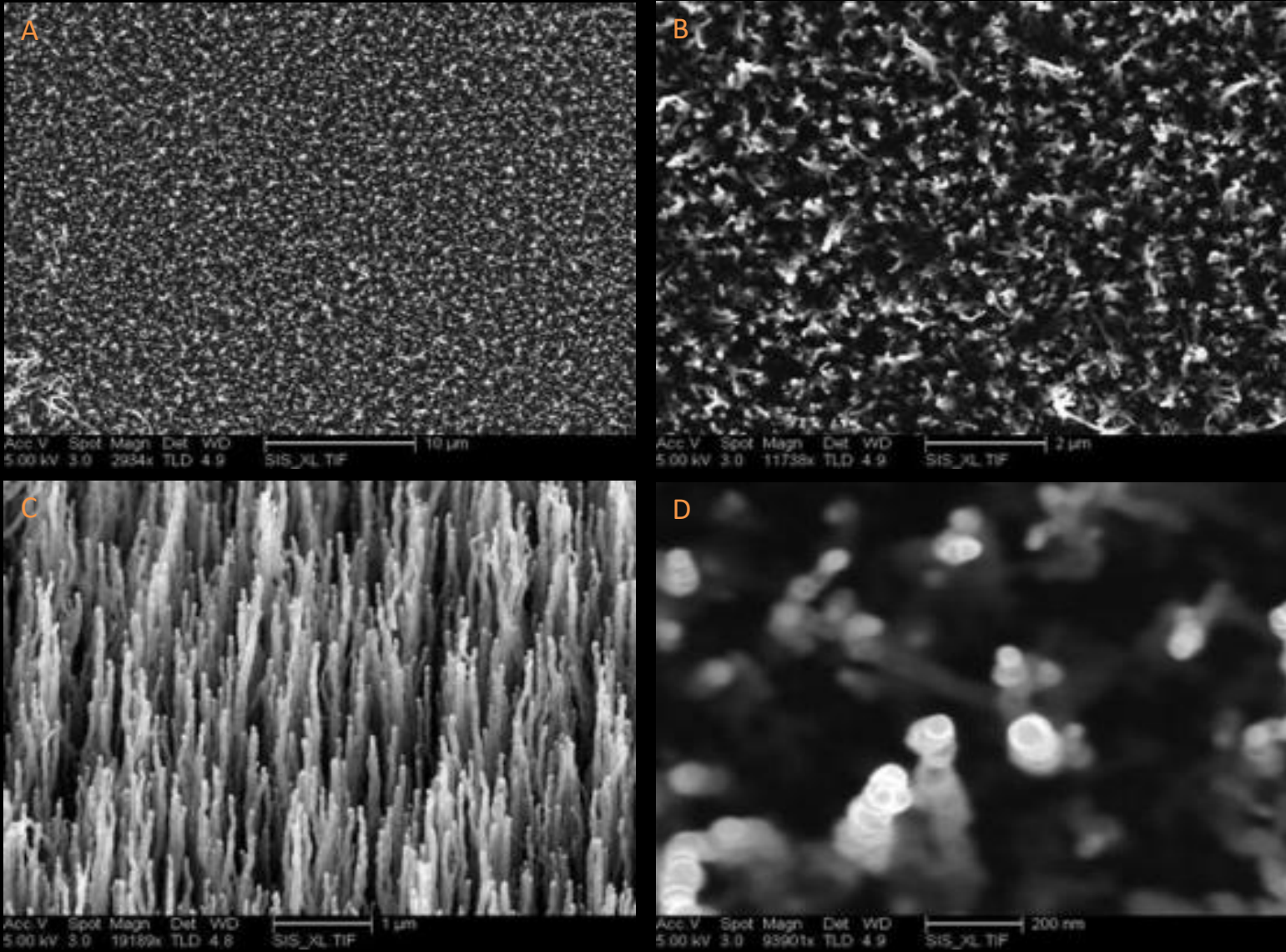


Figure 1 A-D: As-grown CNTs via PECVD using Ni catalyst. Average diameter 100 nm, length 7 μm.

Results

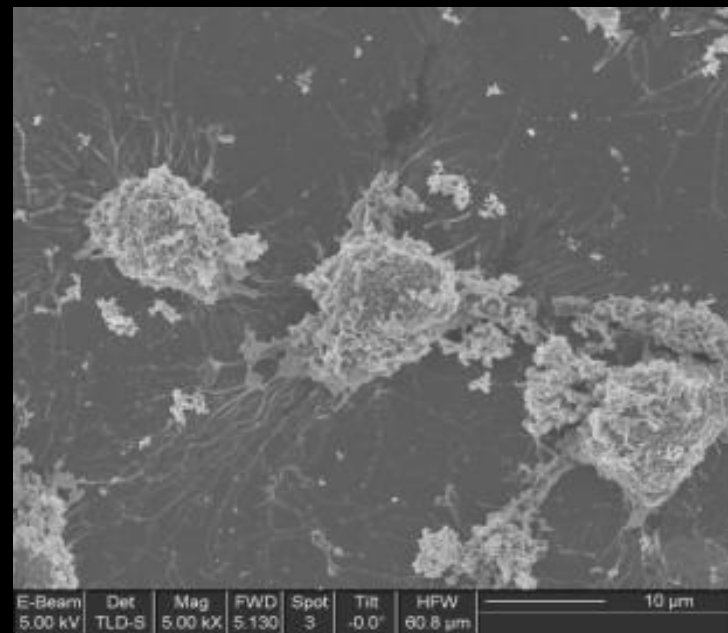
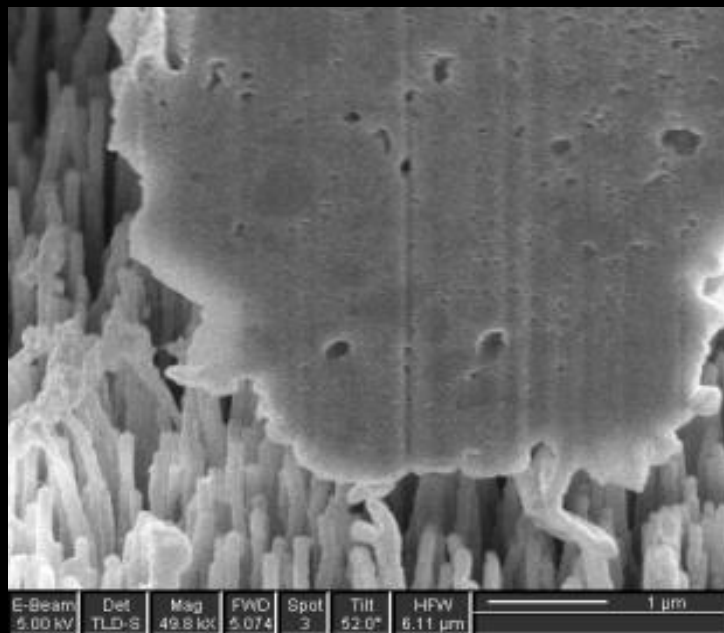
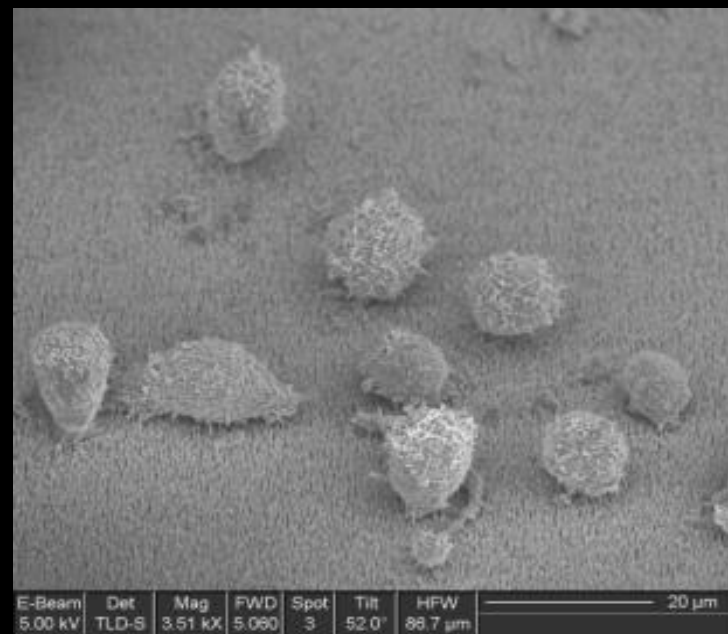
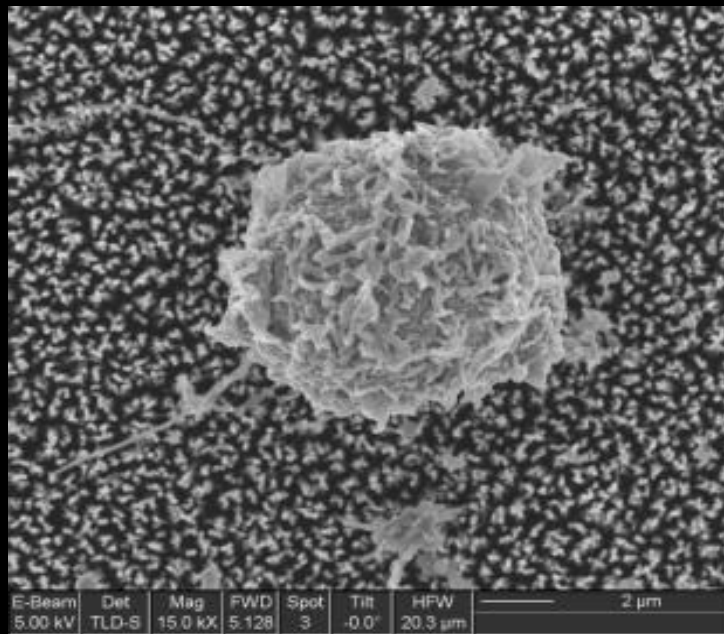


Figure 3 A-D: FIB images of DC 2.4 on bare CNTs

Results

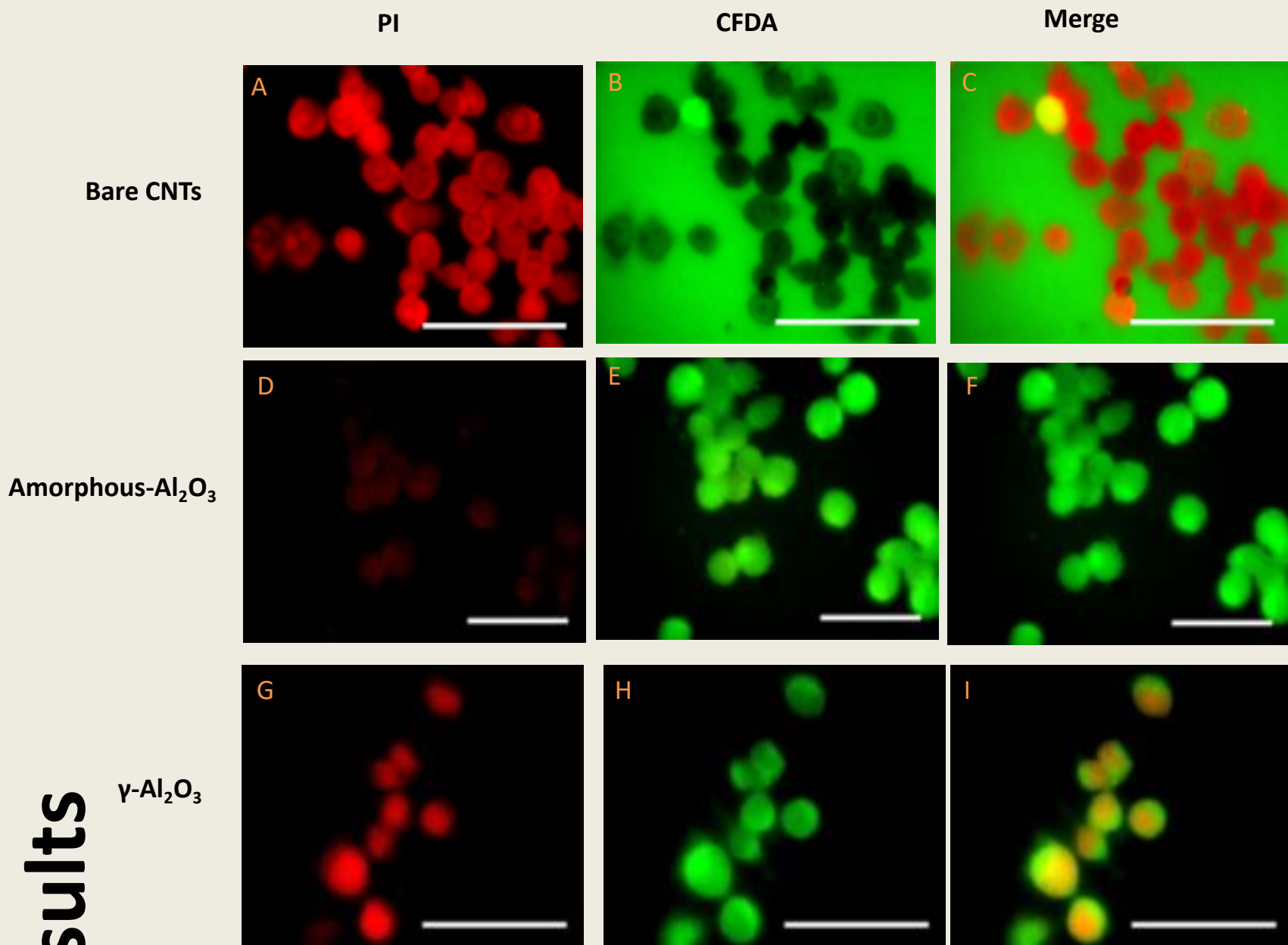


Figure 2 A-I: Bare CNTs, Amorphous-Al₂O₃ and γ -Al₂O₃ with adsorbed DEVD and TNF- α dissolved (Scale bar=60 μ m).

Conclusions

- CNTs, vertically aligned (100 nm diameter) compromise cell membrane
- Amorphous- Al_2O_3 effectively delivered caspase-inhibitor
- Gamma- Al_2O_3 did not effectively deliver caspase-inhibitor
- Transient penetration
- Needle/Syringe effect
- Chemical/mechanical properties

Ongoing Goals

- Dissolution controls
- Gamma-Al₂O₃ functionalization
- Mechanism-time dependent
- Neuron potential probing with CNTs
- Optogenetics

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- Dr. Jun Jiao
- Singer Lab
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Questions?

