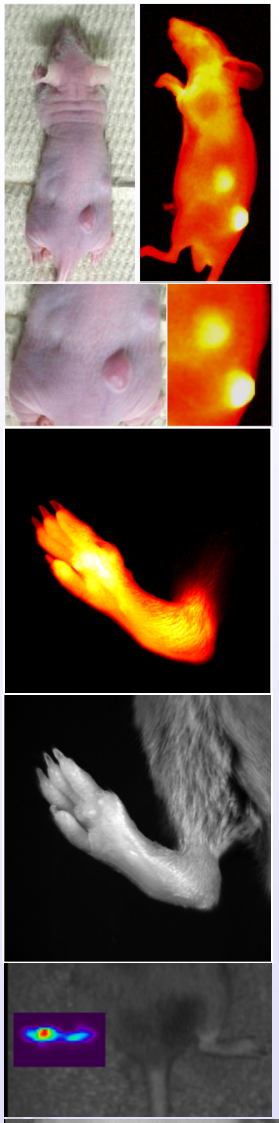


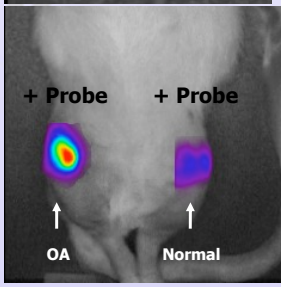
Activatable Molecular Probes for Optical Imaging

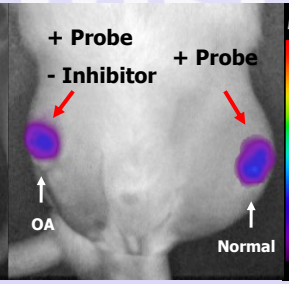
Ick Chan Kwon, Ph.D.

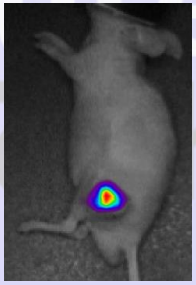
KIST-DFCI On-Site-Lab
Dept. Cancer Biology, Dana Farber Cancer Institute

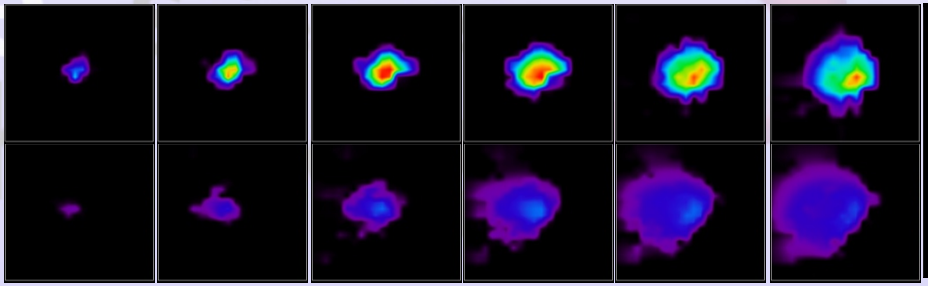
Biomedical Research Institute
Korea Institute of Science & Technology

22 Sep, 2019
The 16th U.S.-Korea Forum on Nanotechnology
Qualcomm Institute, University of California,
San Diego, CA, USA

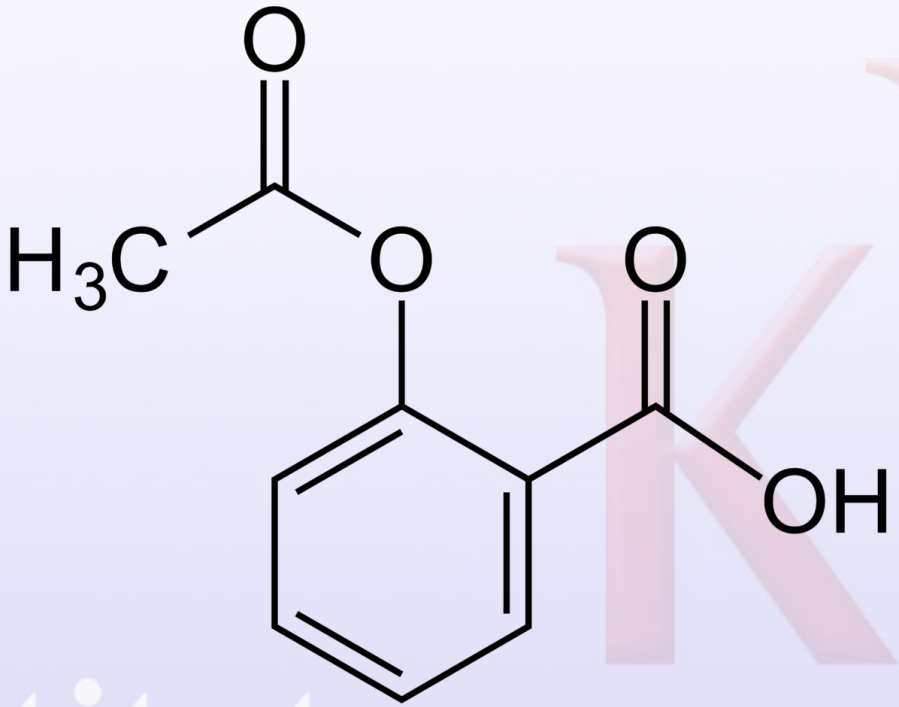








Therapeutic Effect

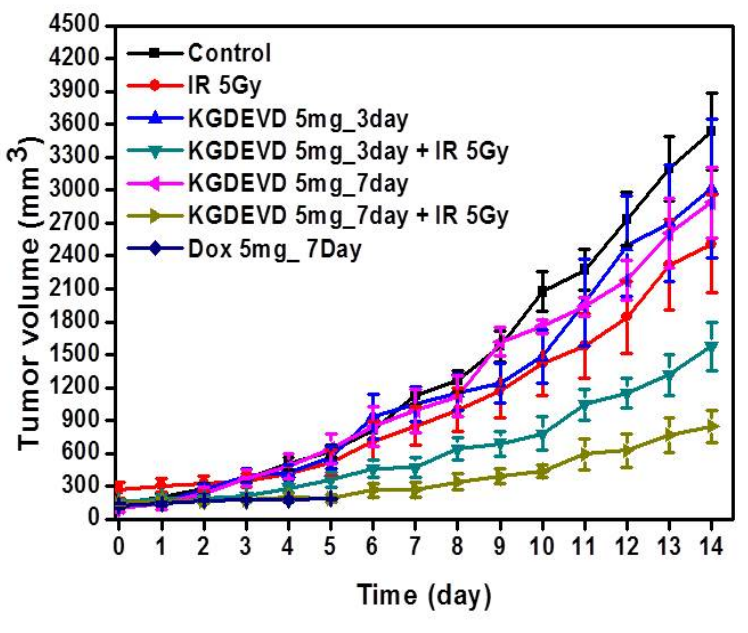


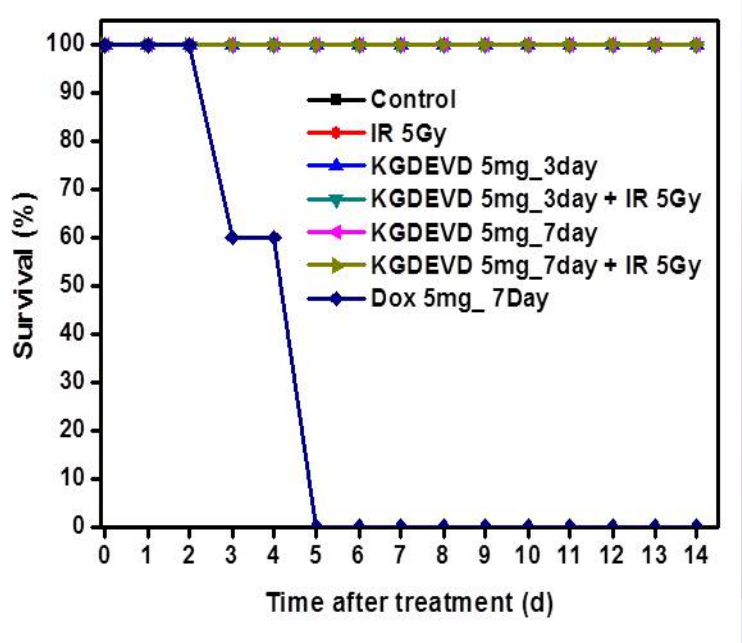
Aspirin

COX (cyclooxgenase) inhibitor

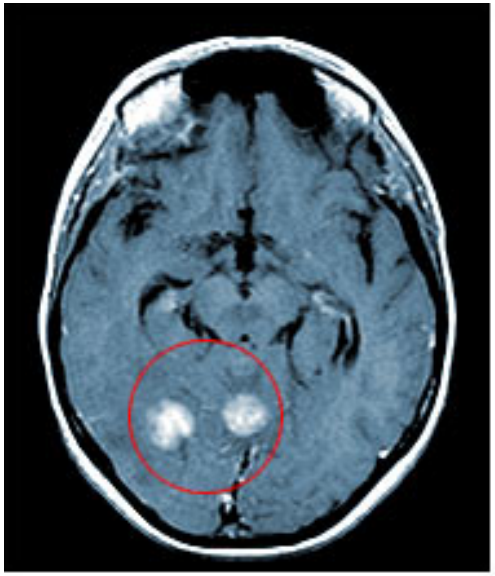
Therapeutic Effect

Evaluation of Therapeutic Efficacy

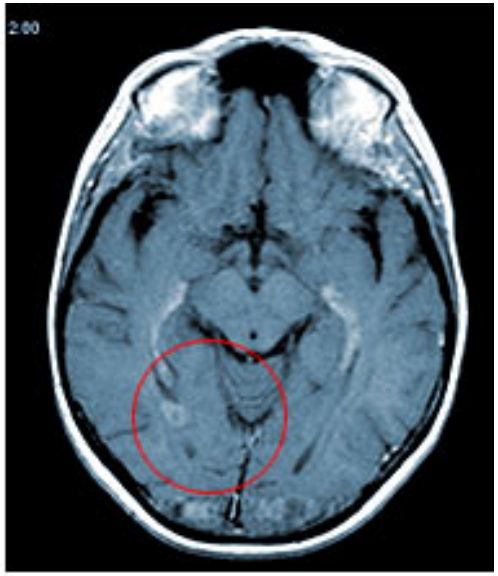




JNCI 2014

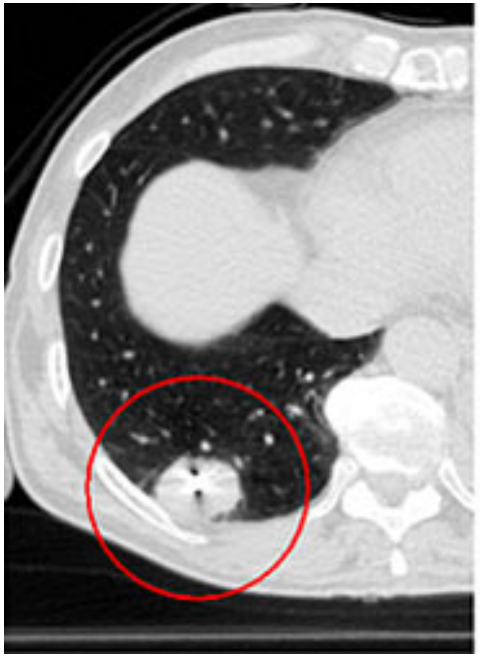


before cyberknife treatment



4 weeks after cyberknife treatment

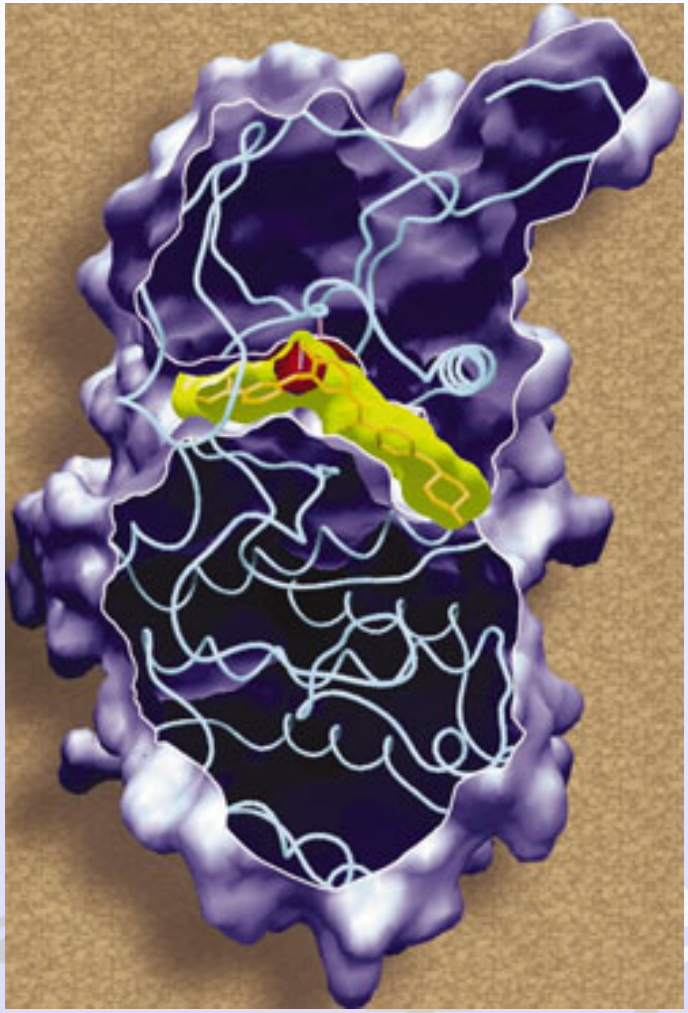
The left image shows MRI scans of a patient harboring 2 brain metastases of a lung carcinoma. Both tumors were treated in a 1 hour treatment session using Cyberknife radiosurgery. The right image shows the first MRI control 4 weeks after treatment. Both tumors are completely eliminated.

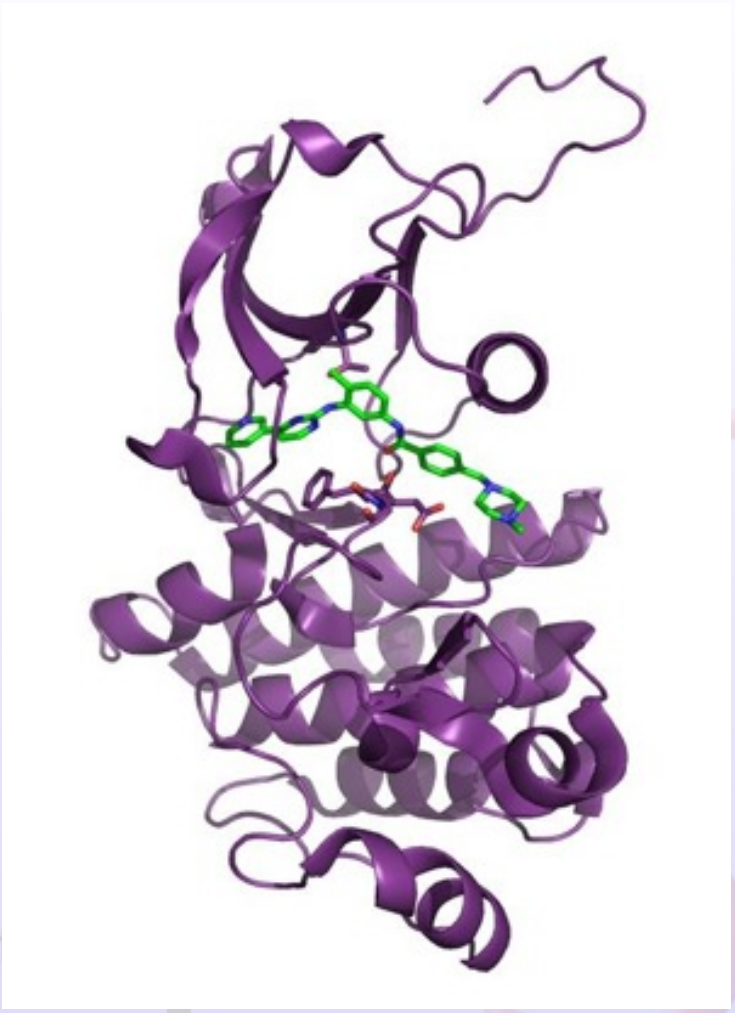


The left image shows a tumor of the lung before Cyberknife treatment. A small (5 mm) fiducial was implanted for real time breath triggered robotic treatment. The right image shows the result 2 weeks after the single session Cyberknife procedure. The tumor is already reduced in size and shows a central necosis.

Photos from website of cyber-knife.net

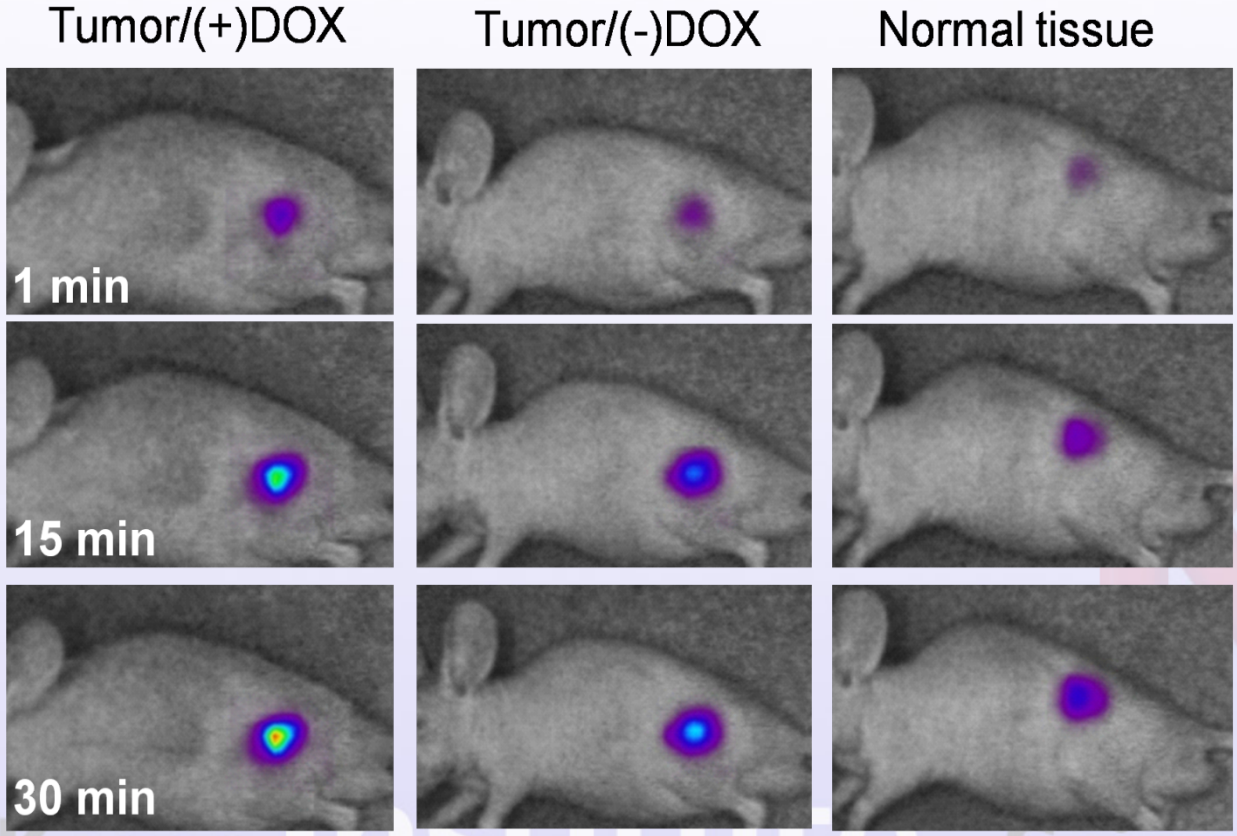
Molecular Medicine
Molecular Therapy

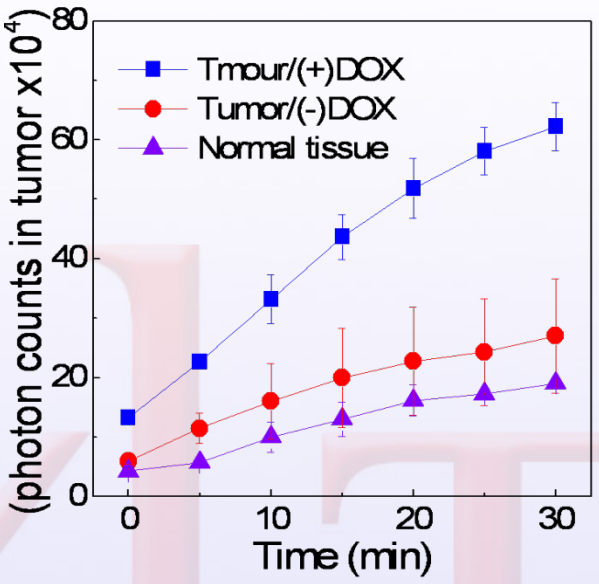


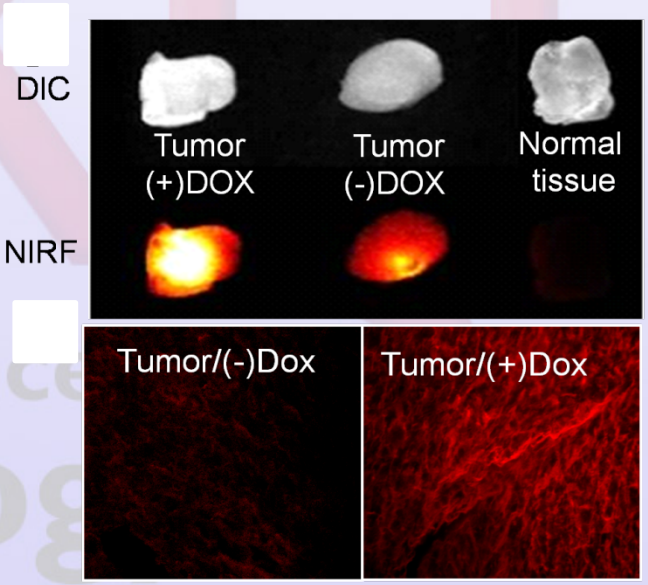


Photos from : Lore Leighton, Laboratory of John Kuriyan
Photos from MIT open course 5.36 Biochemistry Laboratory

Visualize Apoptosis







Bioconjugate Chemistry, 22 (2011) 125

Molecular Imaging

- Visualization of biological process
- Molecular events at molecular and cellular level
- In living systems
- Using remote imaging detectors

"The characterization and measurement of biological processes in living animals, model systems, and humans at the cellular and molecular level by using remote imaging detectors"

Lucker GD and Piwnica-Worms D *Acad. Radiol.* 2001;8;4

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In vivo molecular target assessment of matrix metalloproteinase inhibition

CHRISTOPH BREMER, CHING-HSUAN TUNG & RALPH WEISSLEDER

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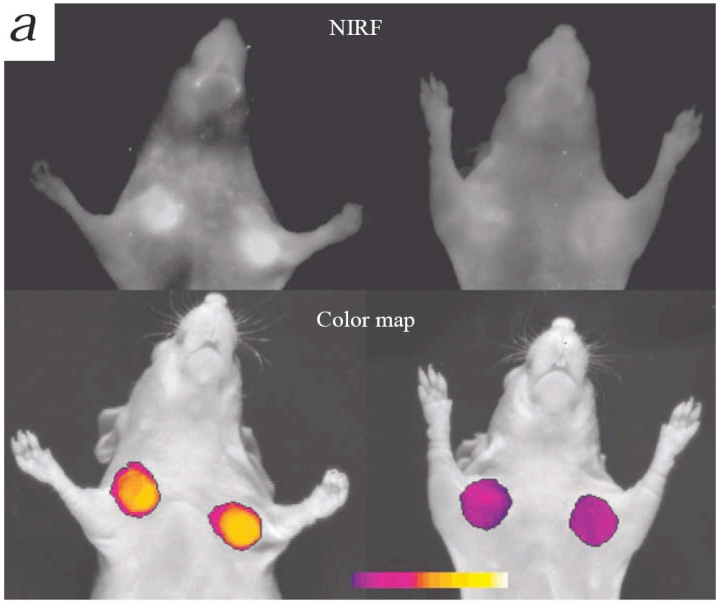
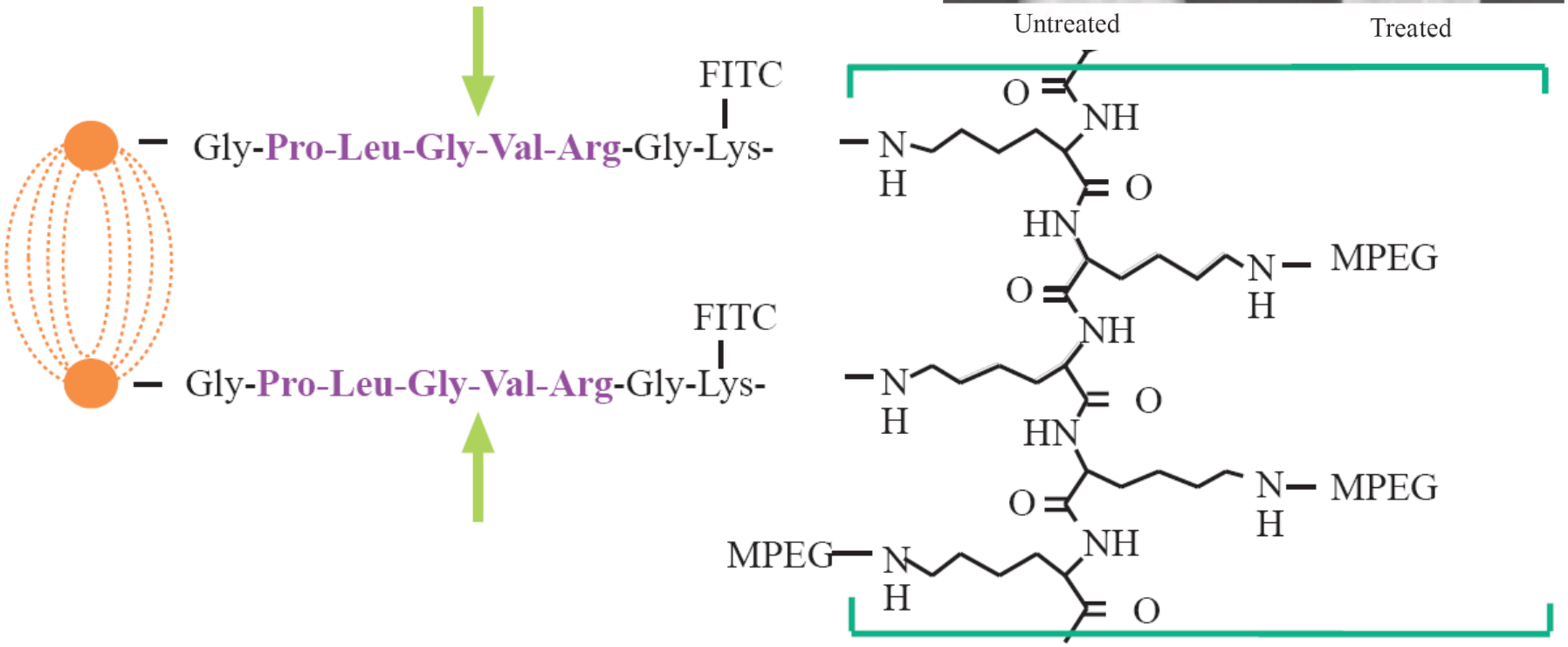
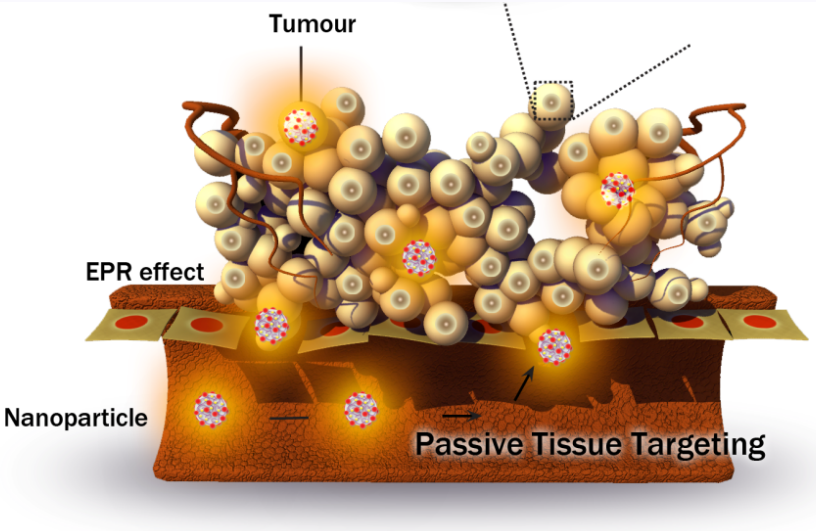
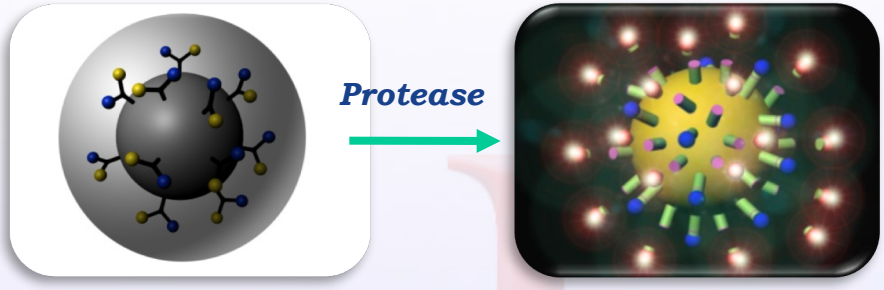
Correspondence should be addressed to C-H.T. or R.W.;
email: tung@helix.mgh.harvard.edu or weissleder@helix.mgh.harvard.edu



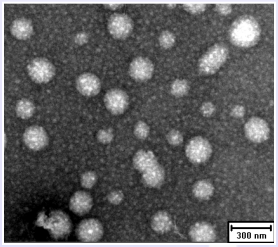


Nanoparticles for Activatable Probe





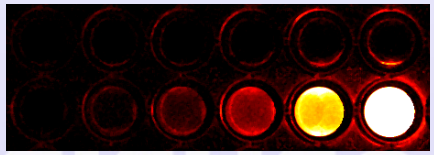

Polymeric Nanoparticles



Quenching properties

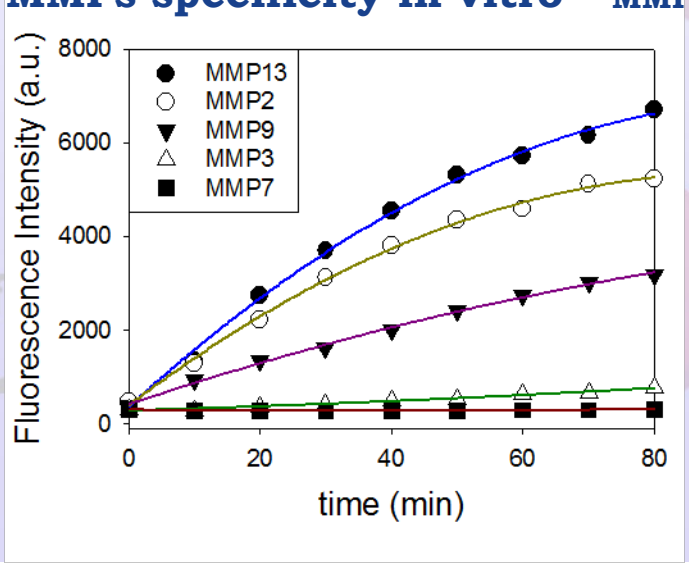
- MMP

+ MMP

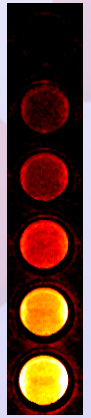


Probe concentrations

MMPs specificity in vitro



MMP-2 Conc. mmol/L



0

0.55

1.1

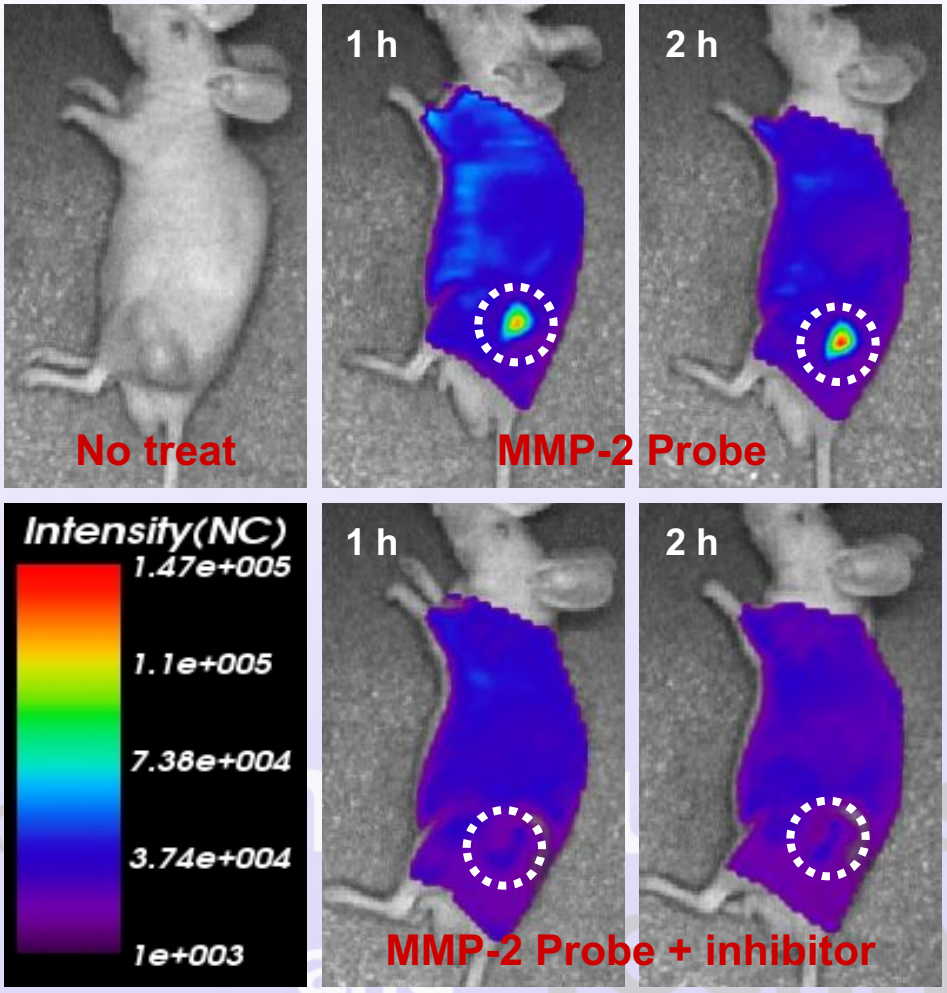
2.2

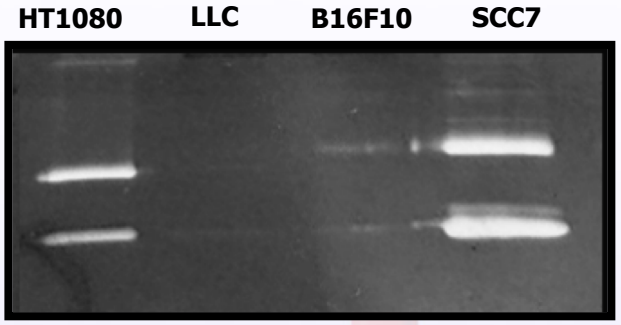
5.5

11

Nanoparticles for Activatable Probe

In vivo image (eXplore Optix)

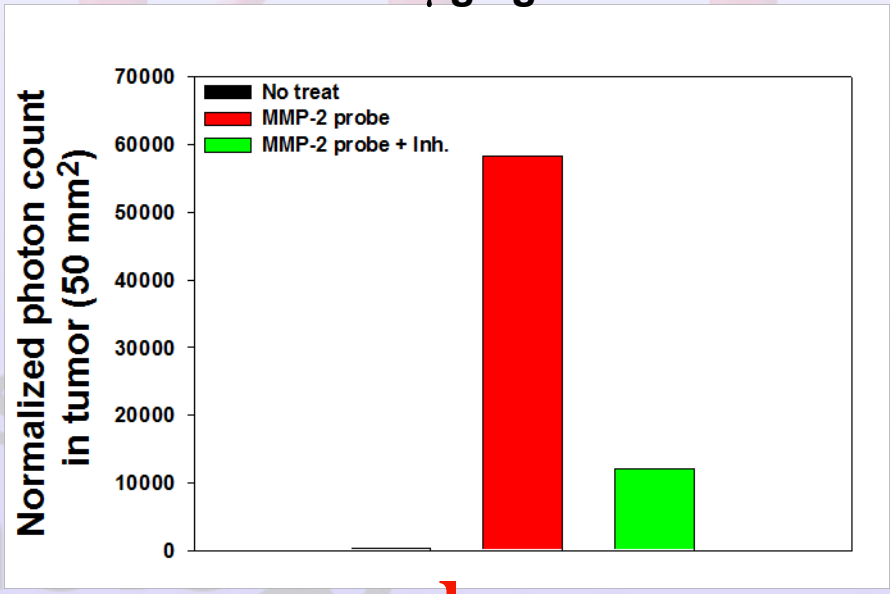




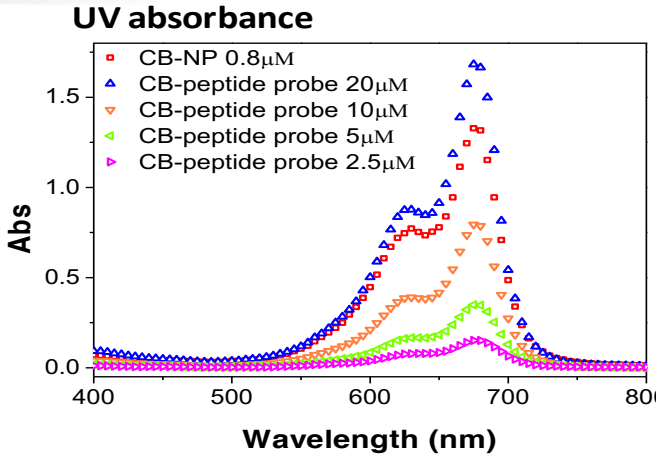
1: Tumor: SCC7

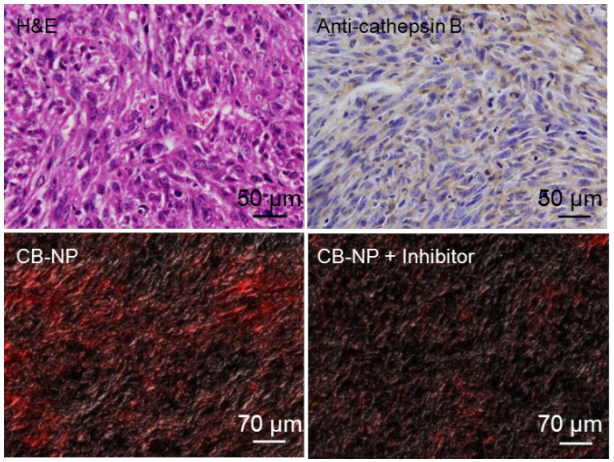
2: MMP-2 probe: 5 mg/kg

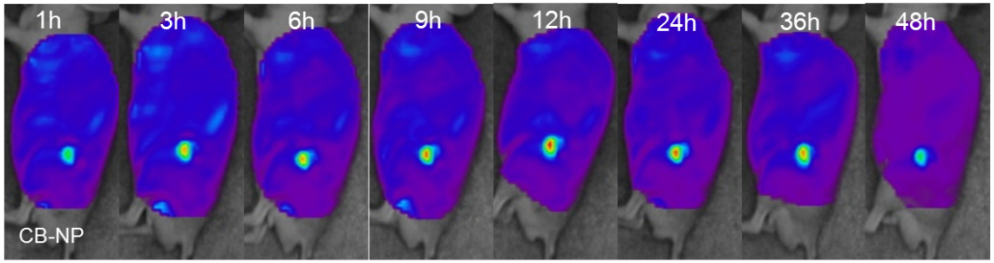
3: MMP-2 inh.: 100 μg/kg

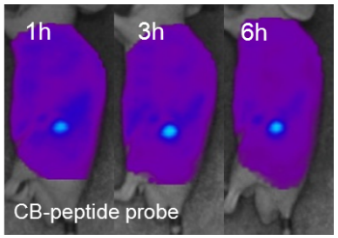


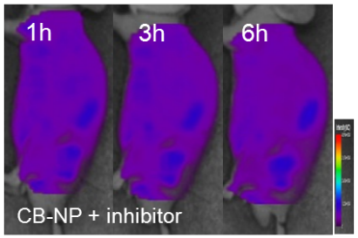
Cathepsin B-specific nanoprobe (CB-NP) for cancer

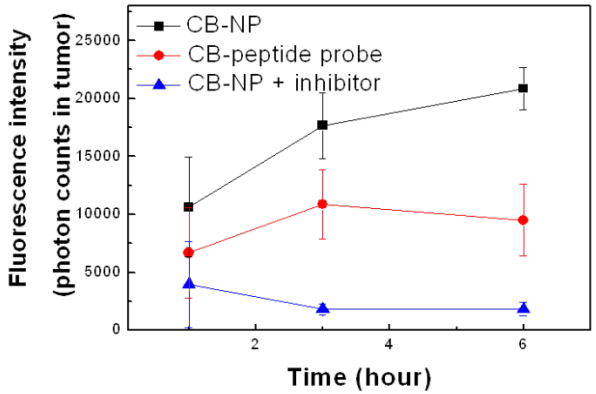


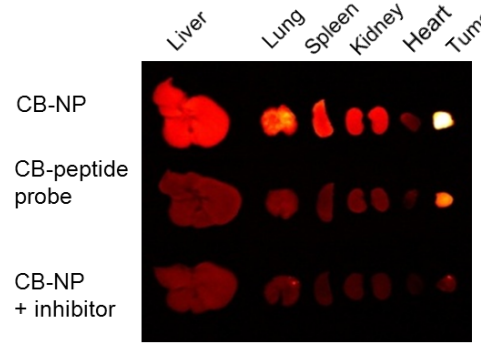


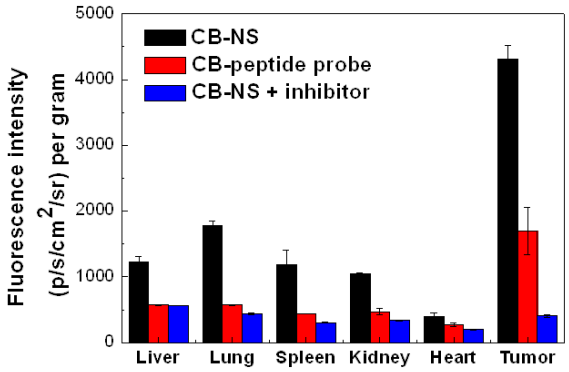










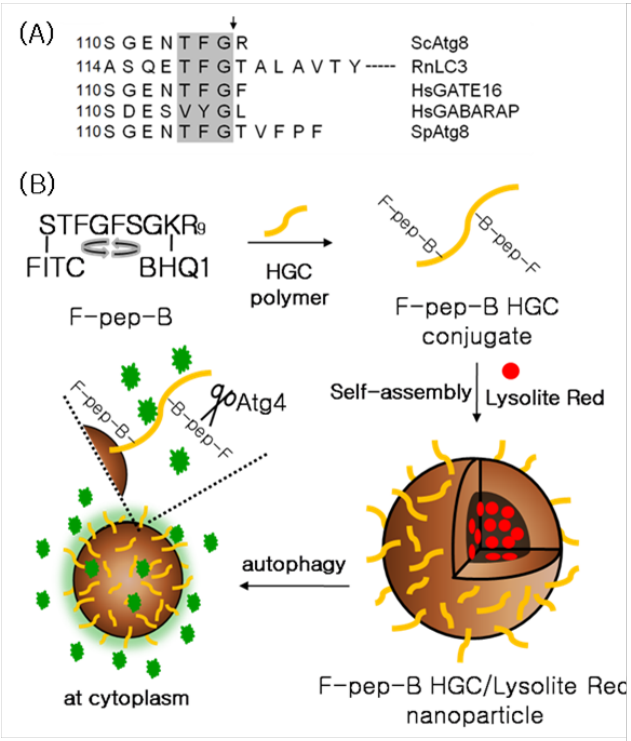


Ryu et al. Journal of Materials Chemisry 2011;21;17631

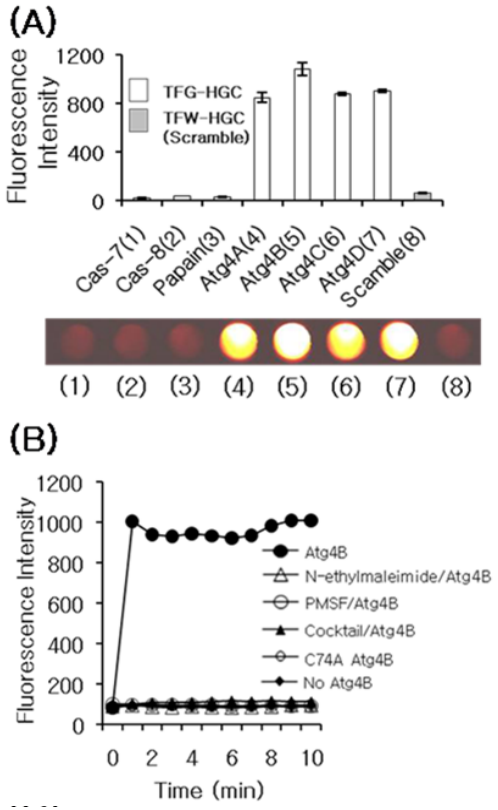
Real-time imaging of autophage in living cells

Korea Institute of Science and Technology

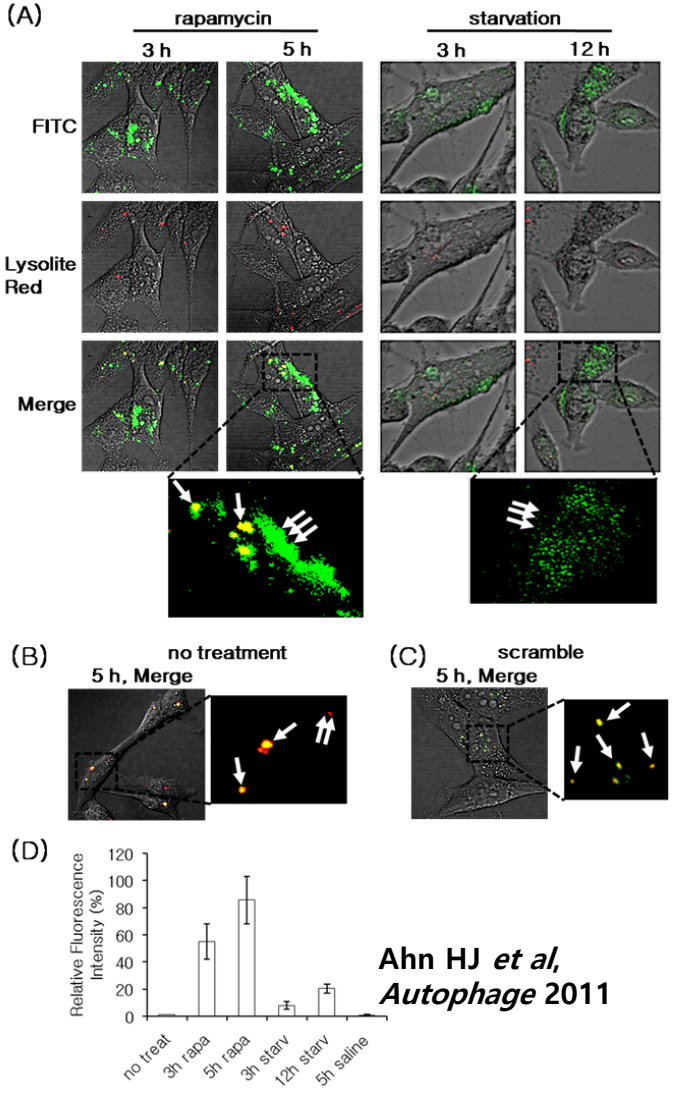
Design of activatable probe



Specificity test against Atg4 protease

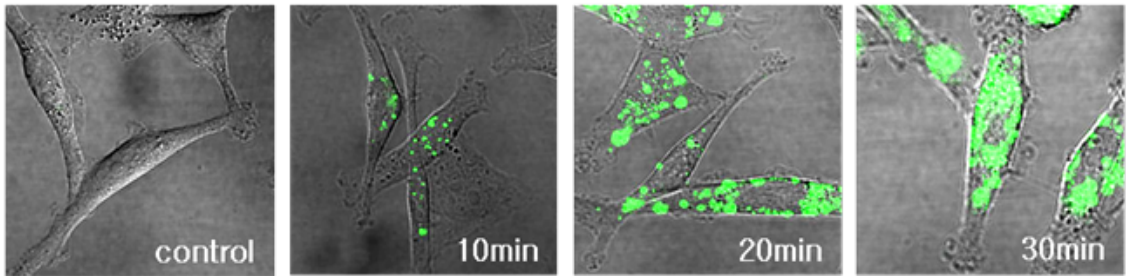


Fluorescence microscopy under autophagy condition induced with rapamycin or starvation

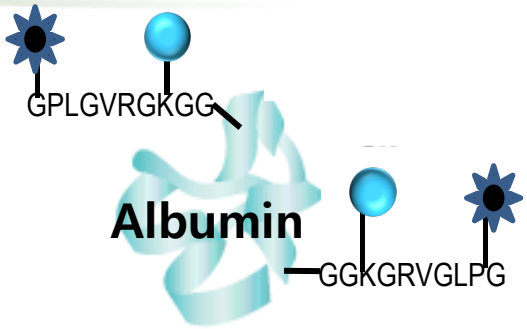


Ahn HJ *et al*, *Autophage* 2011

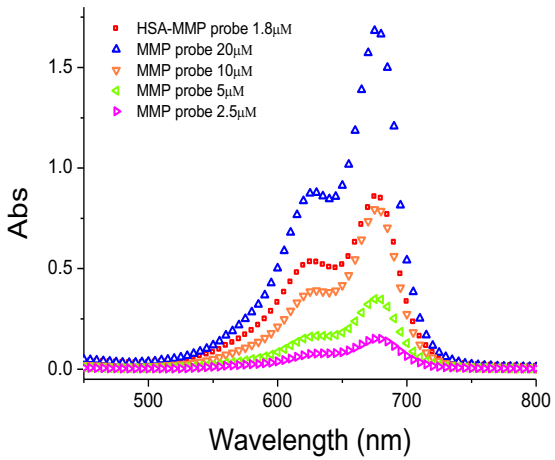
Cellular uptake of FITC-labeled probe

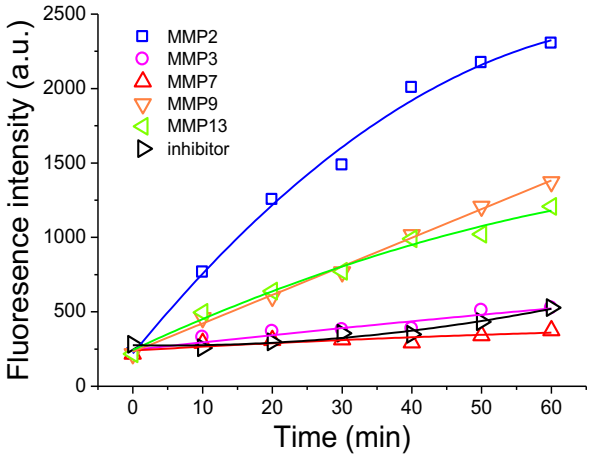


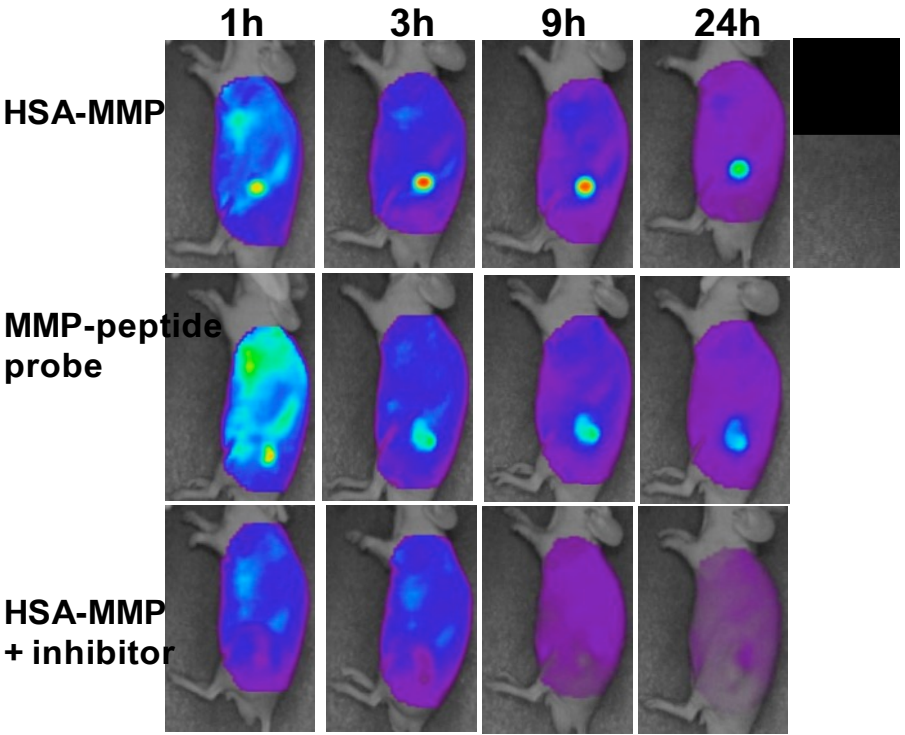
Albumin-conjugated MMP nanoprobe for cancer

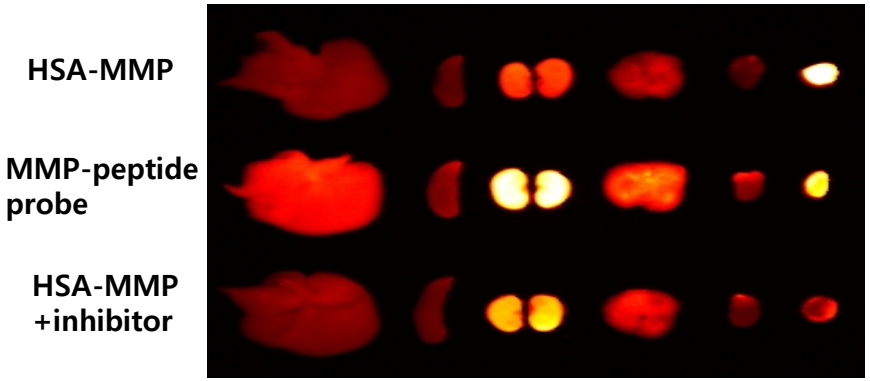


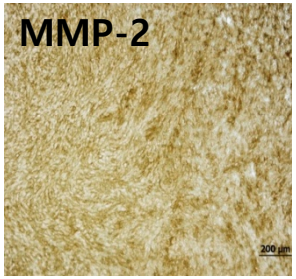
Human Serum Albumin(HSA) -conjugated Probe

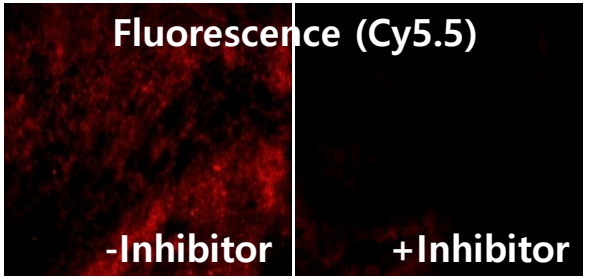








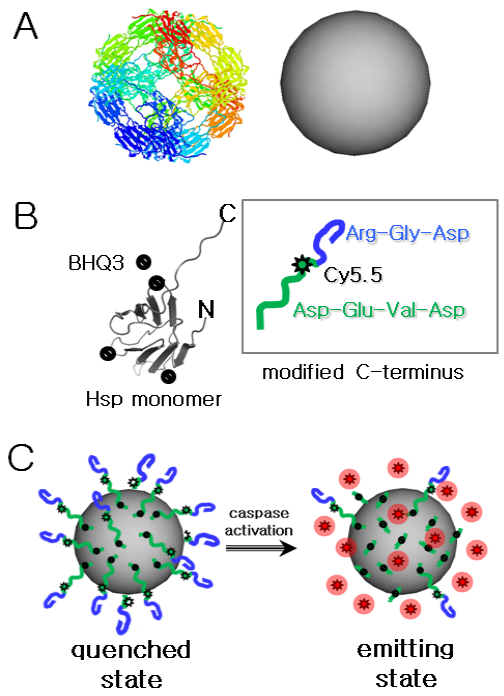




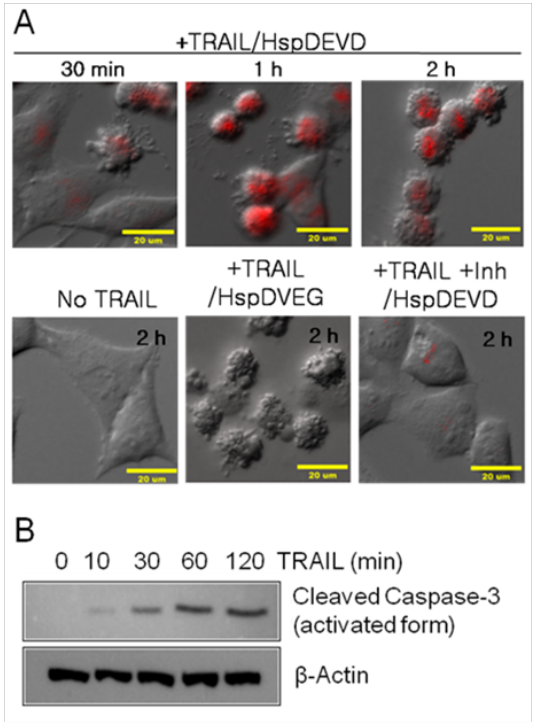
Biomimetic Cage protein for Apoptosis Imaging

Korea Institute of Science and Technology

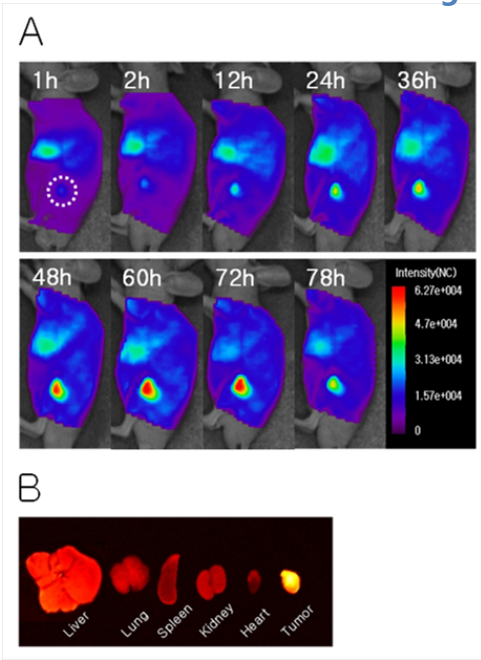
Design of Cy5.5-HspDEVD-BHQ3



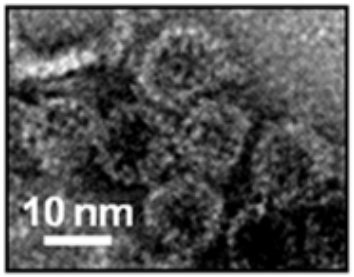
Apoptosis imaging using cage probe



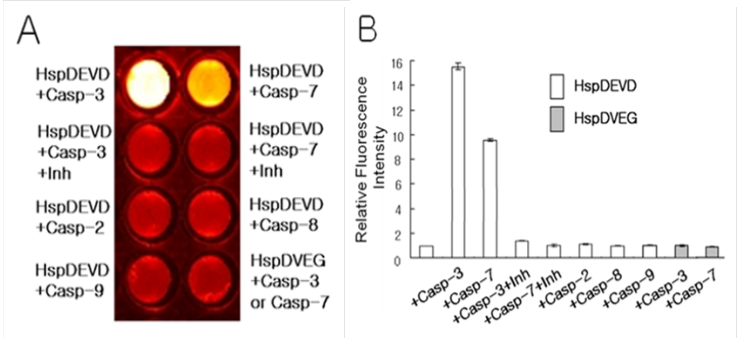
In vivo biodistribution of cage probe



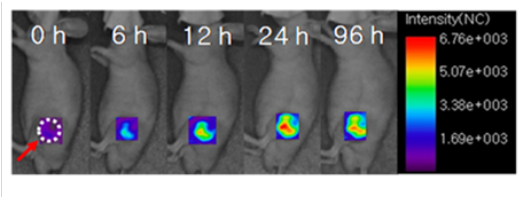
TEM analysis



Caspase specificity test

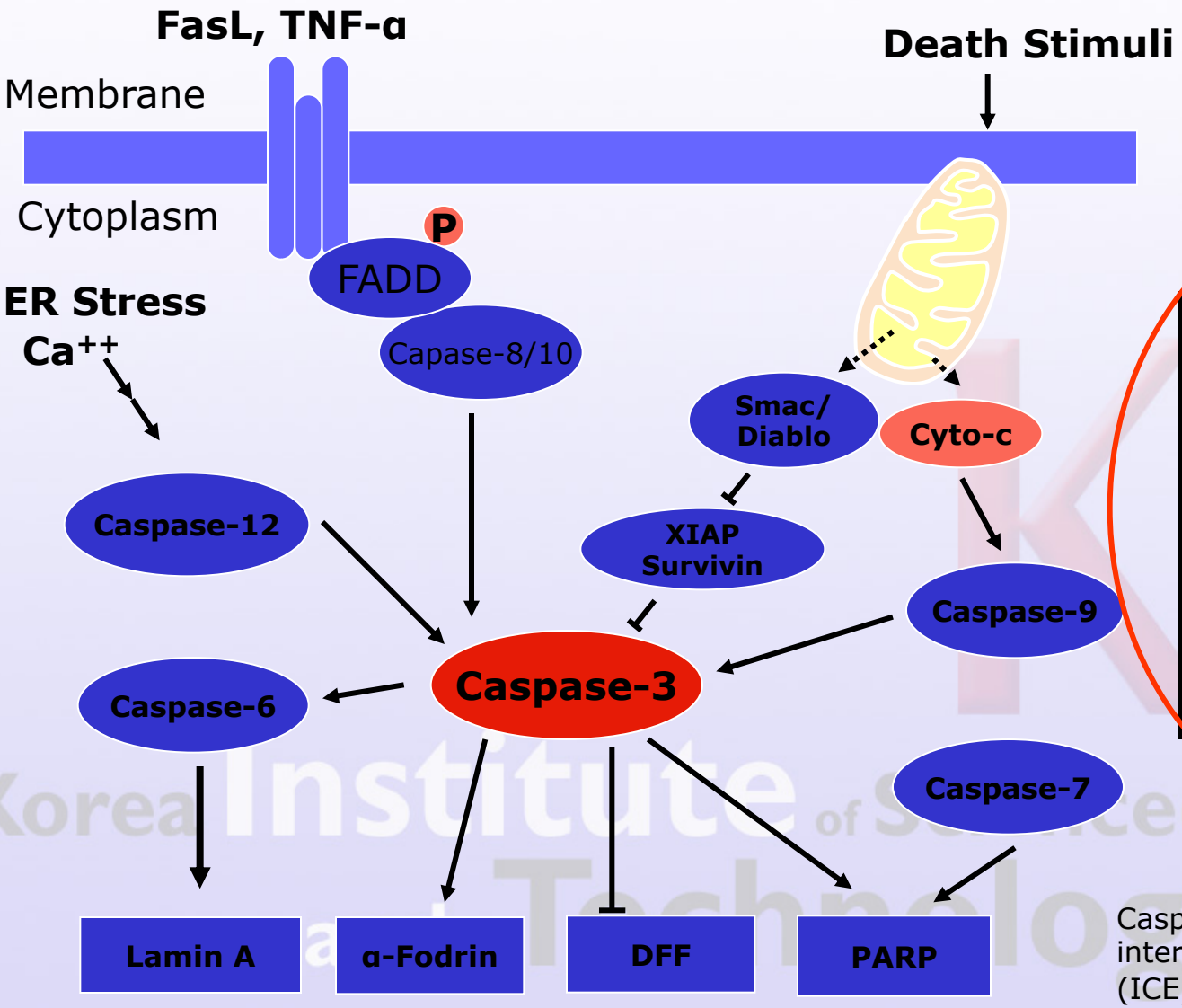


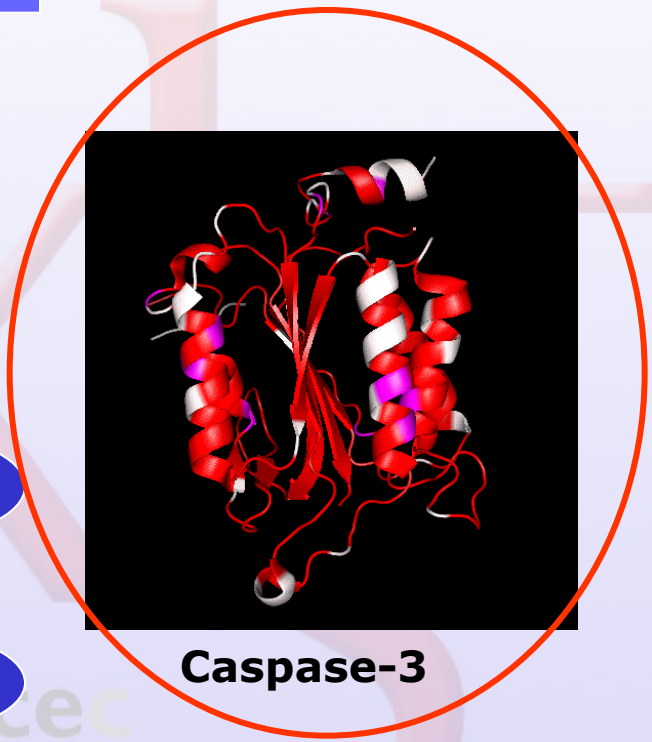
Therapeutic evaluation of anticancer drug using cage nanoprobe



Ahn HJ *et al*, ***Biomacromolecules*** 2011

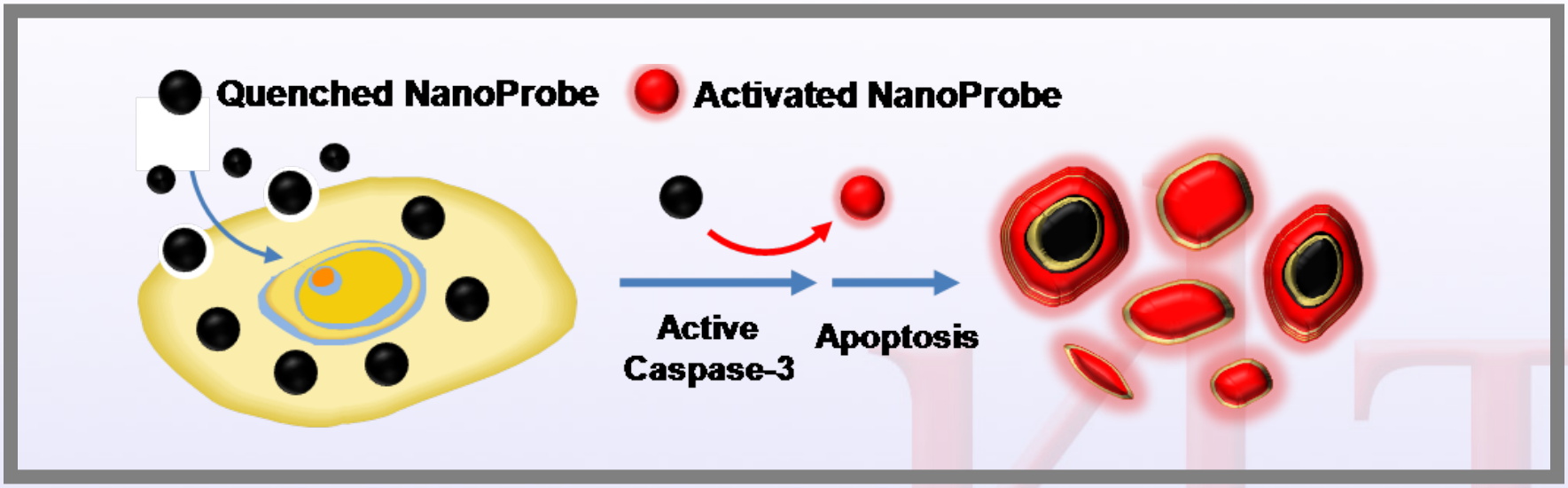
Target Protein for Apoptosis

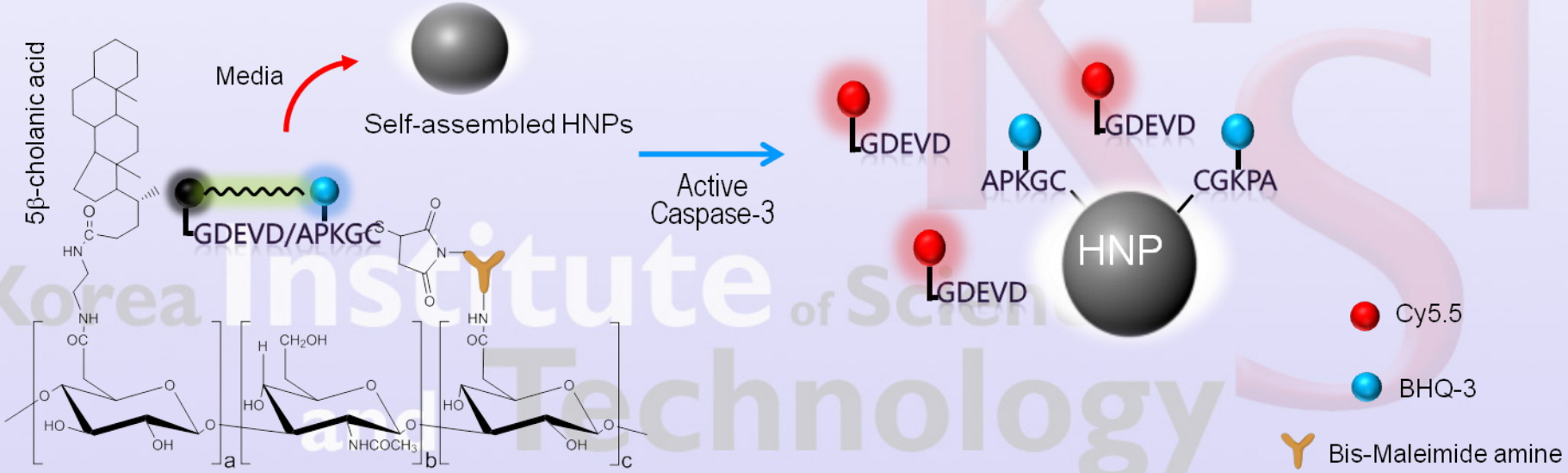




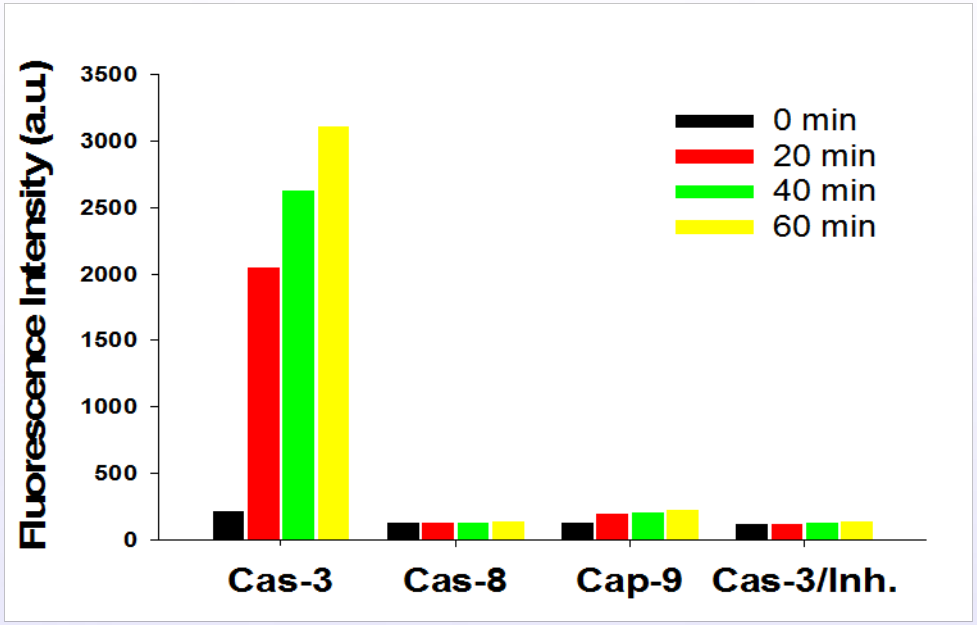
Caspase-3 is a member of the interleukin-1beta converting enzyme (ICE) family of cysteine proteases

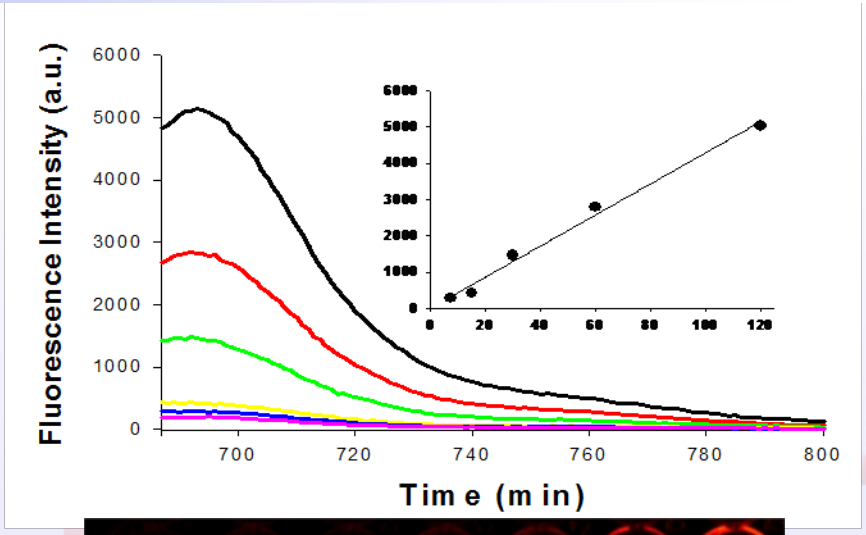
Visualize Apoptosis

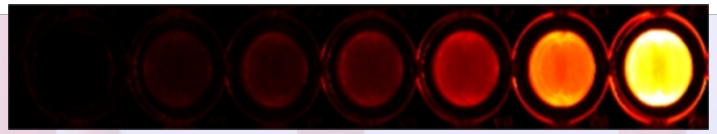




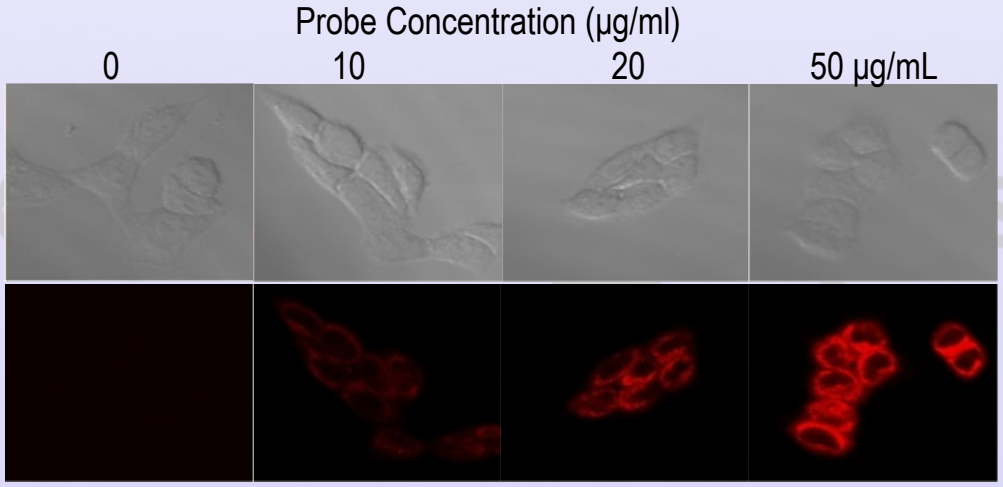
Visualize Apoptosis



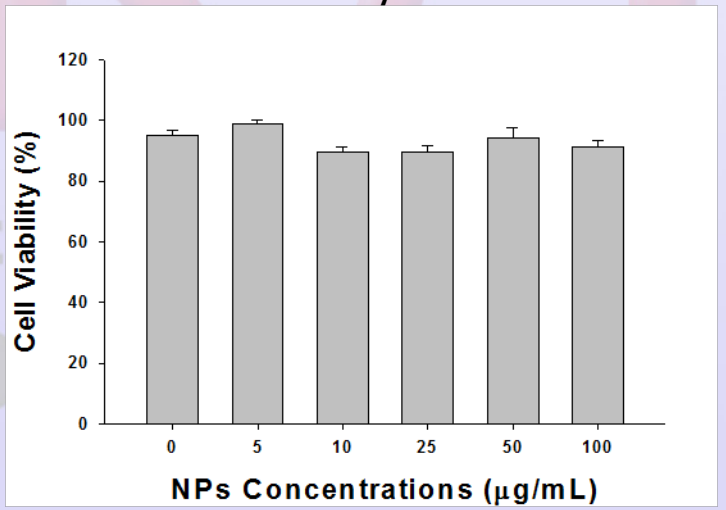




- Cellular uptake



- Cellular viability



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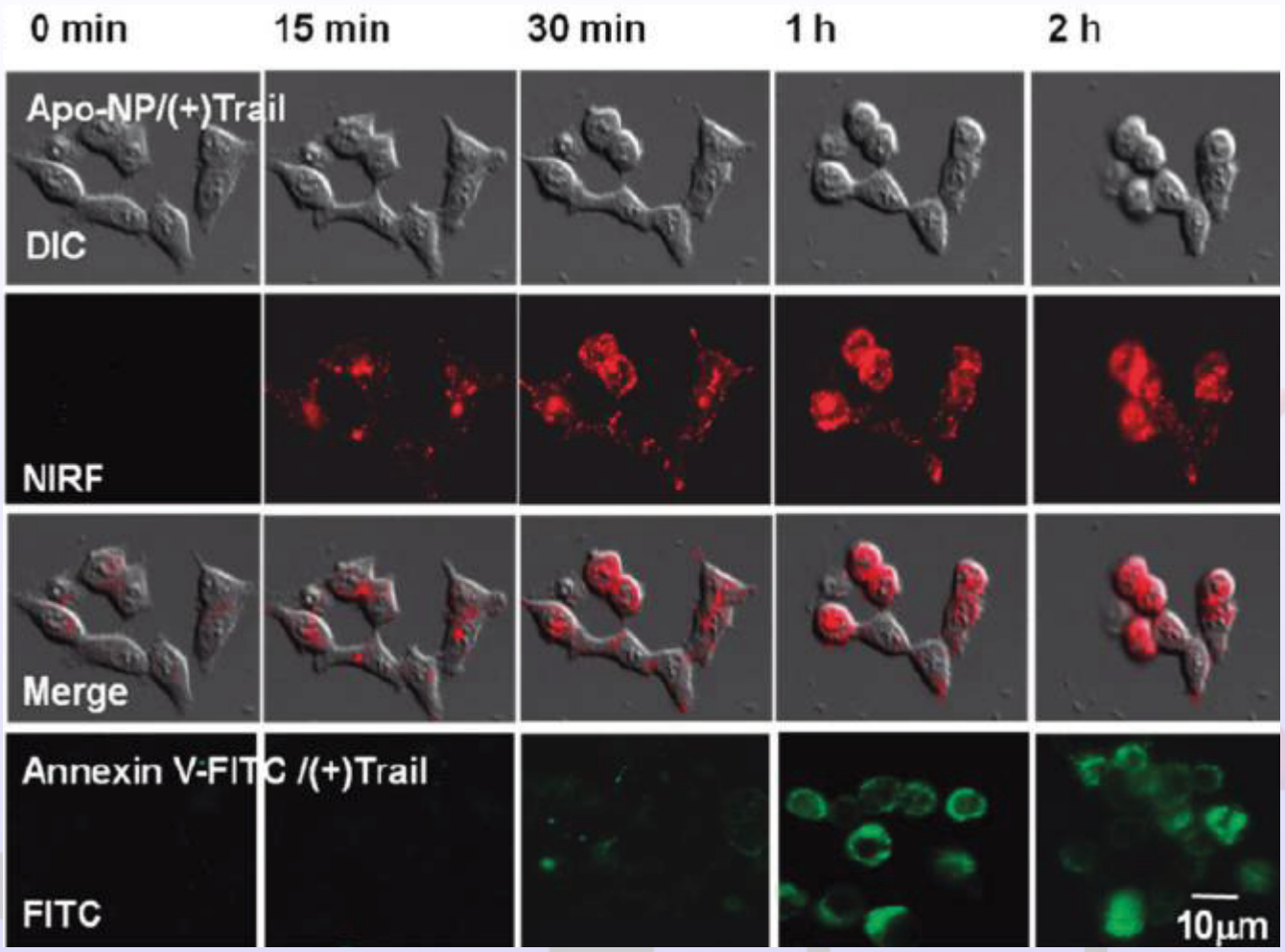
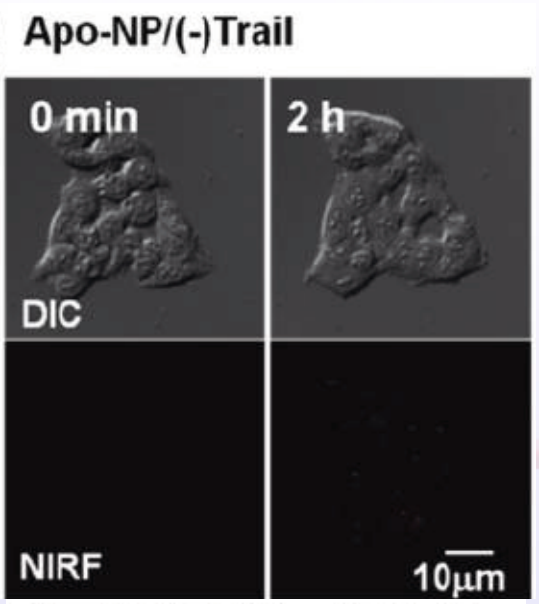
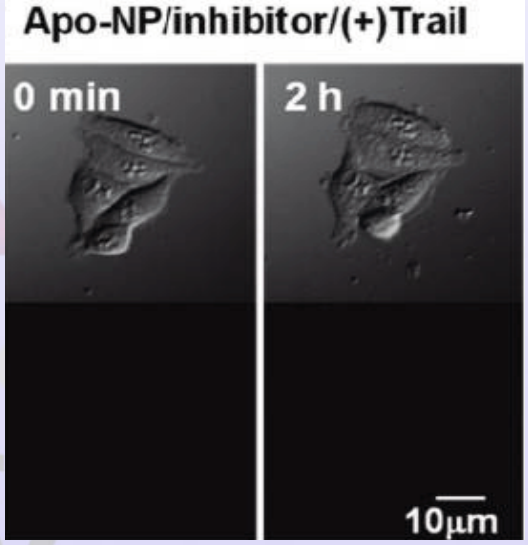
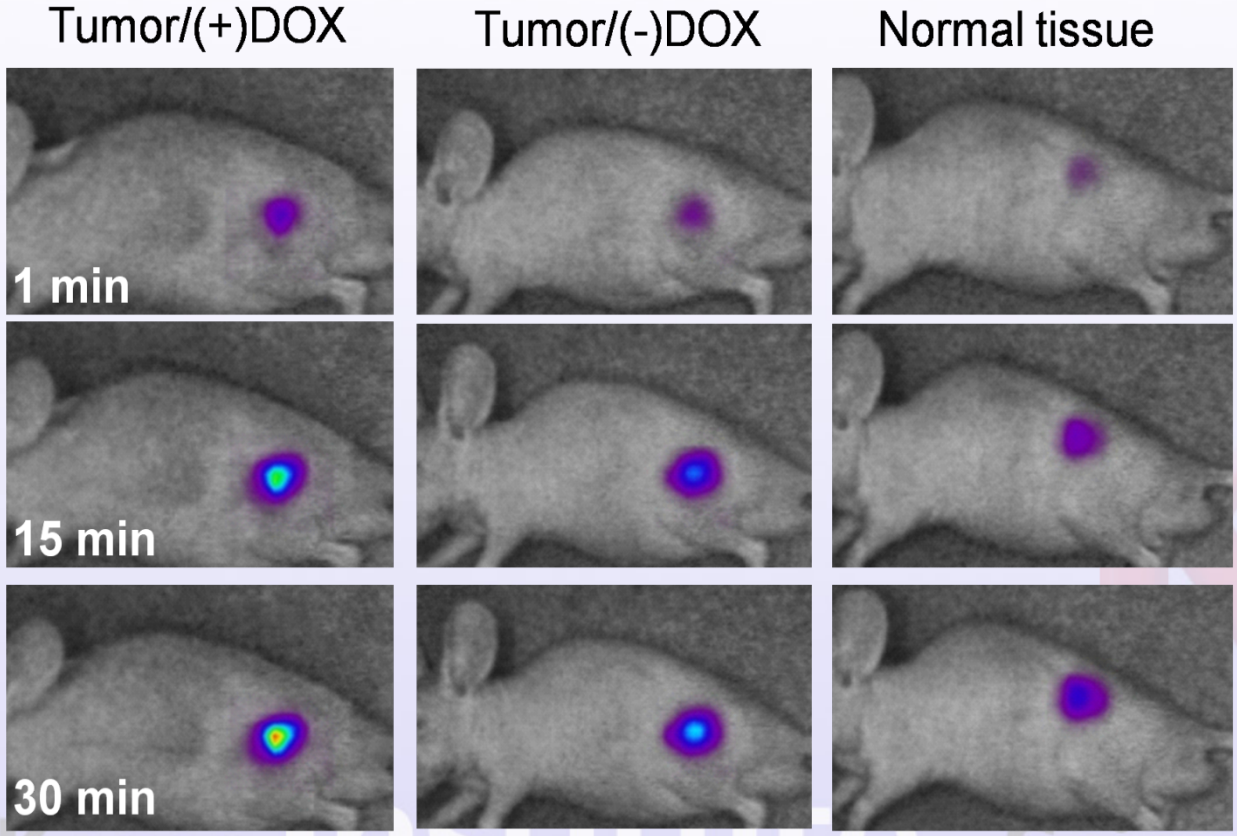


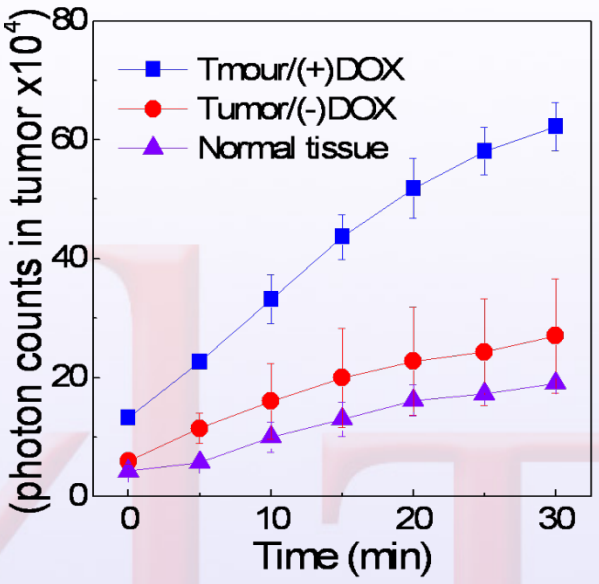


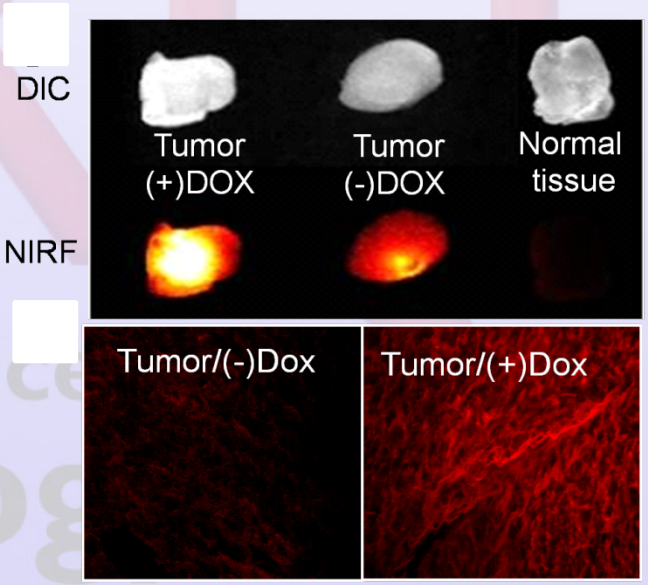


Bioconjugate Chemistry, 22 (2011) 125

Visualize Apoptosis

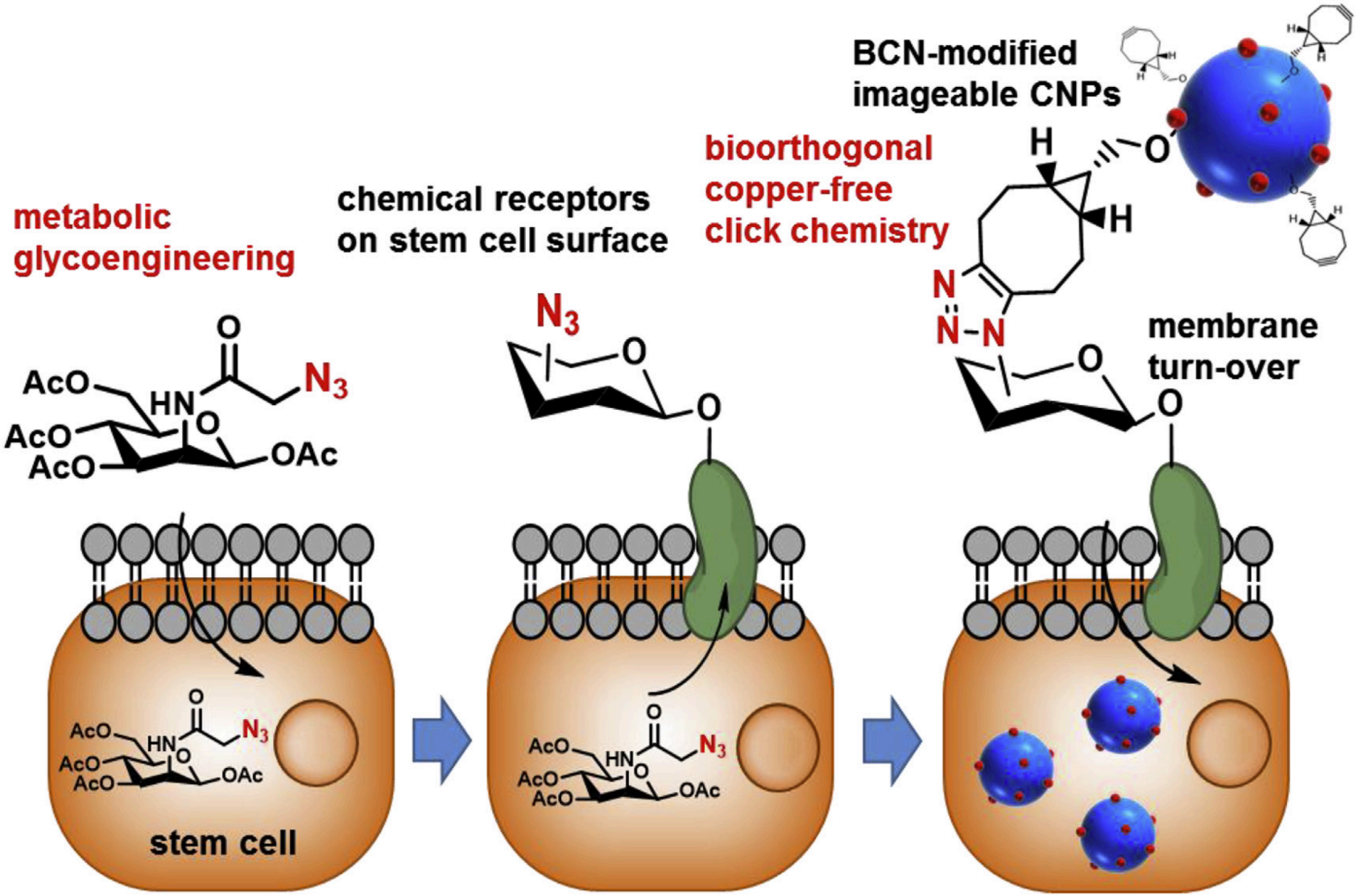






Bioconjugate Chemistry, 22 (2011) 125

Stem Cell Labeling and Tracking



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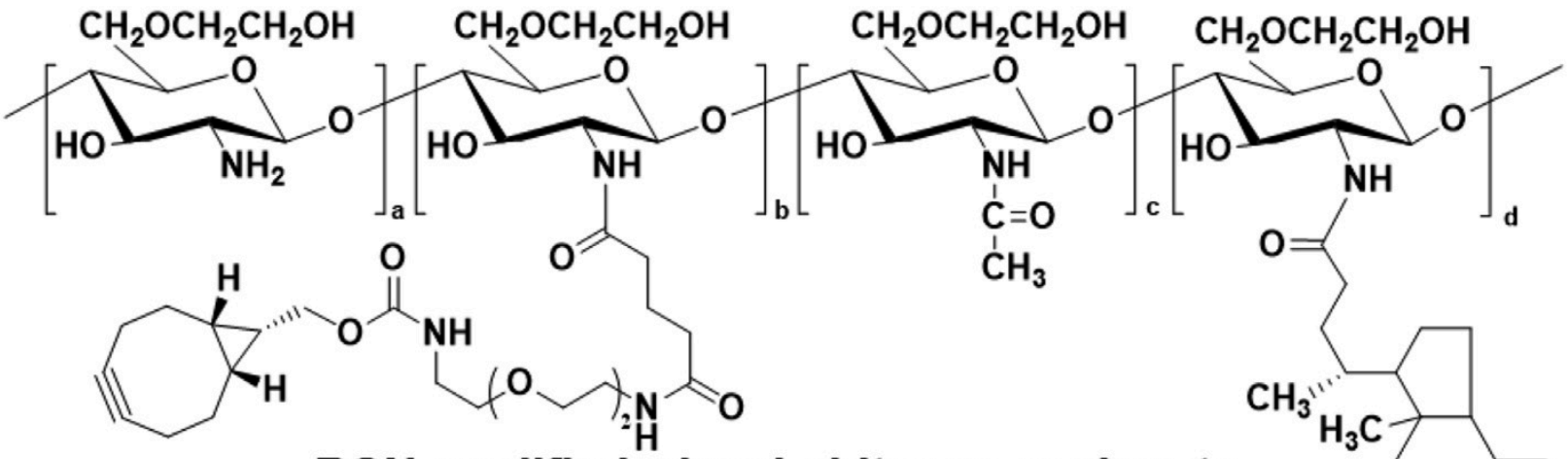
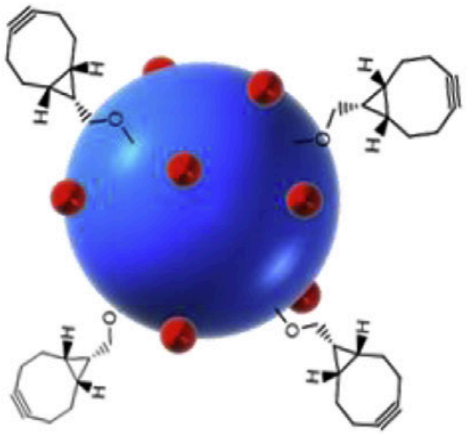
Stem Cell Labeling and Tracking



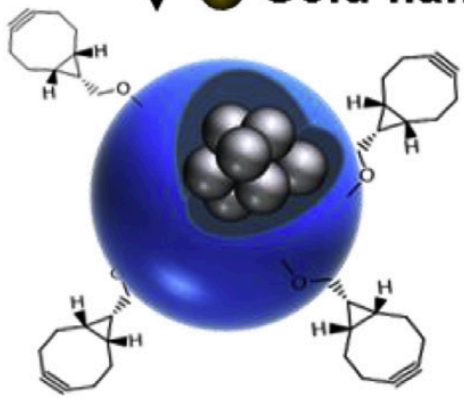
BCN-modified glycol chitosan conjugate

Self-assembled nanoparticles in aqueous condition

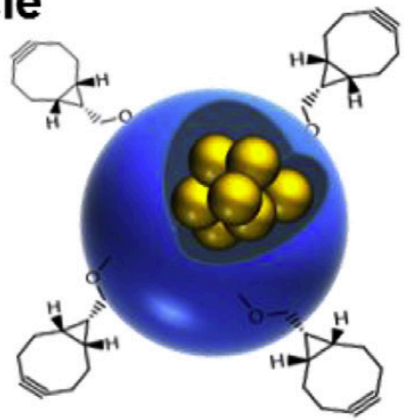
- Cy5.5
- Iron oxide nanoparticle
- Gold nanoparticle



BCN-CNP-Cy5.5

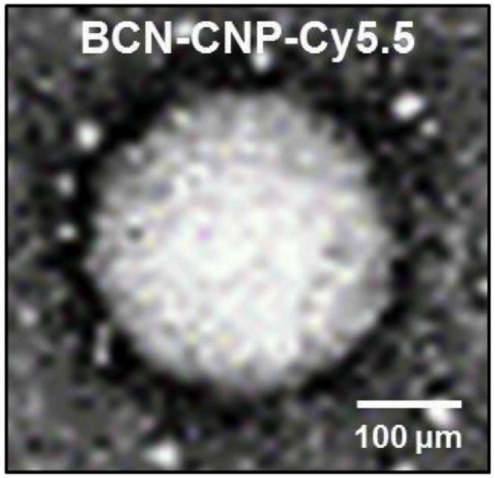


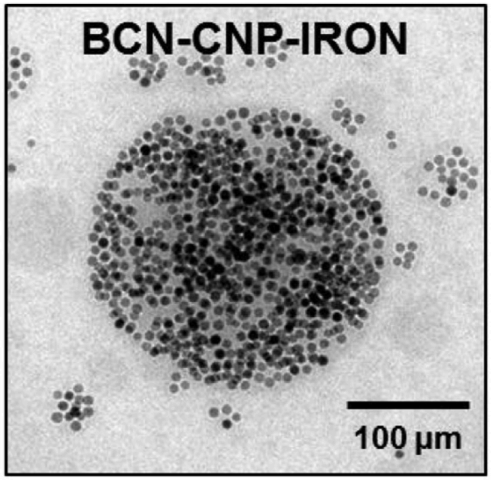
BCN-CNP-IRON

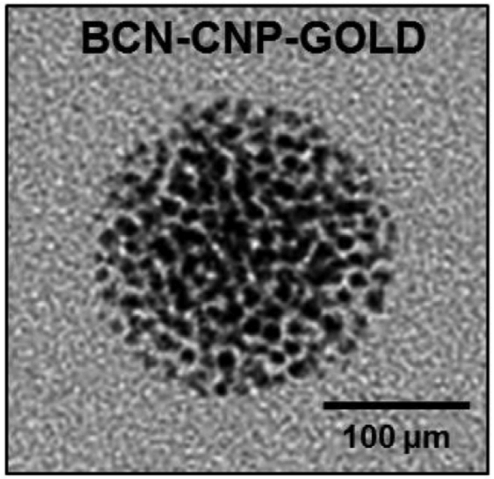


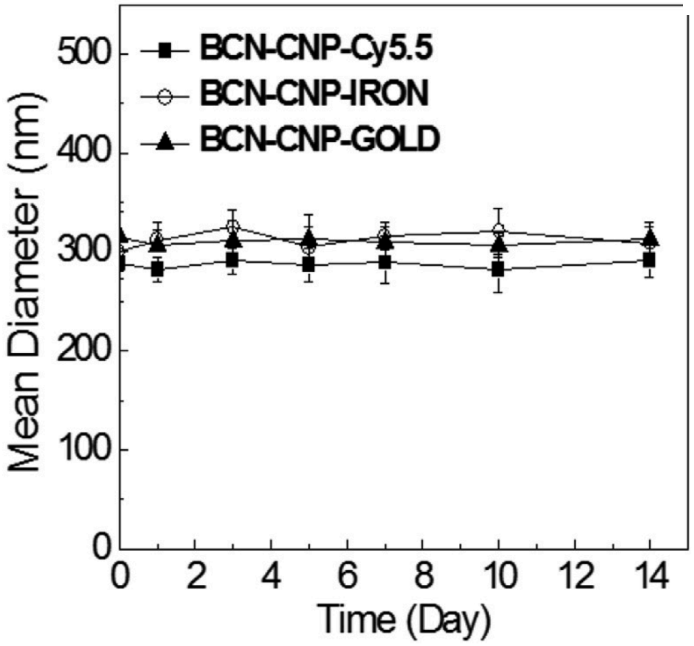
BCN-CNP-GOLD

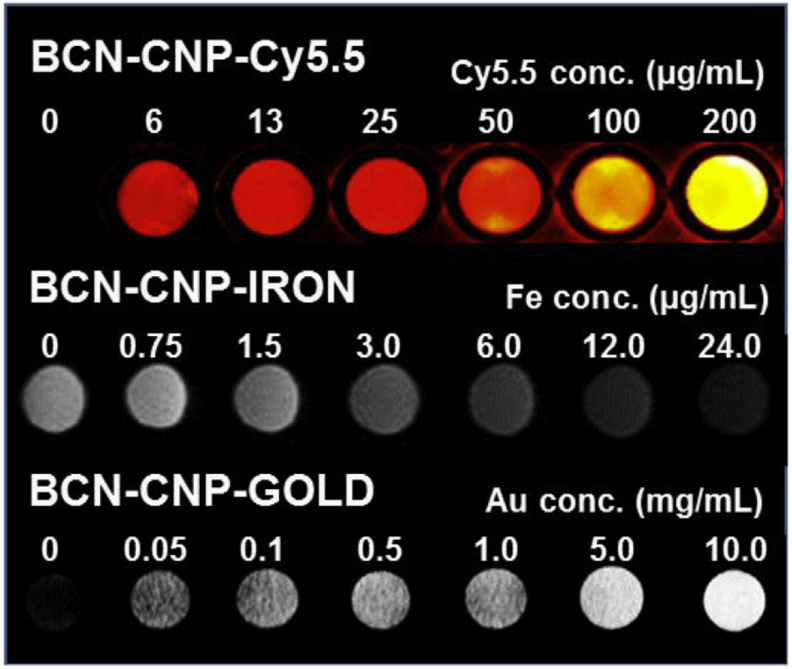
Stem Cell Labeling and Tracking











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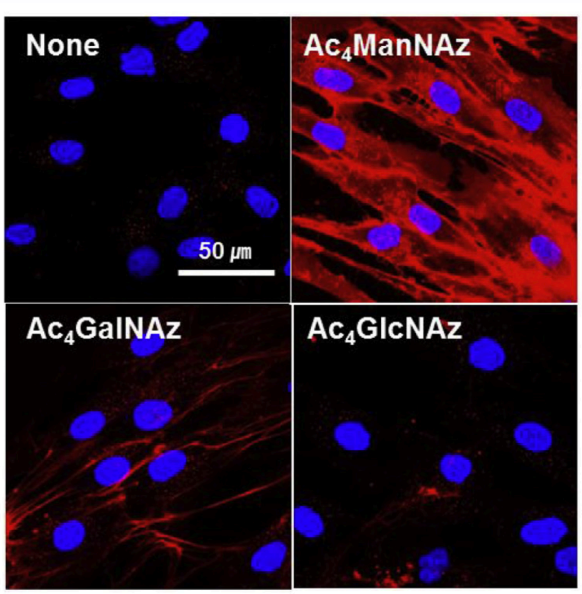
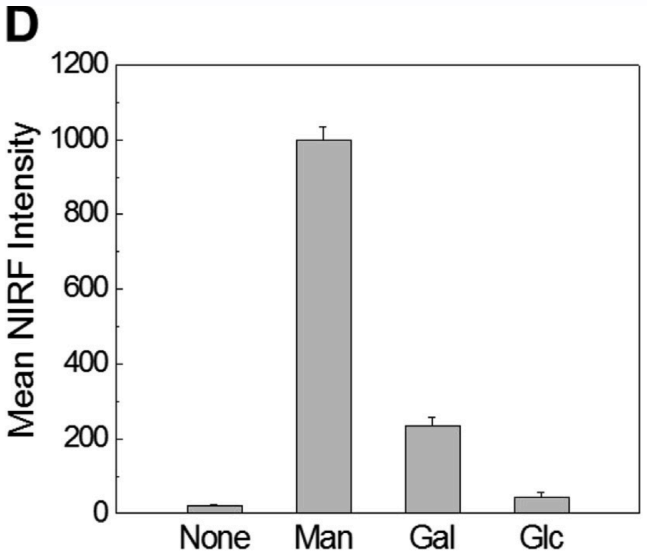
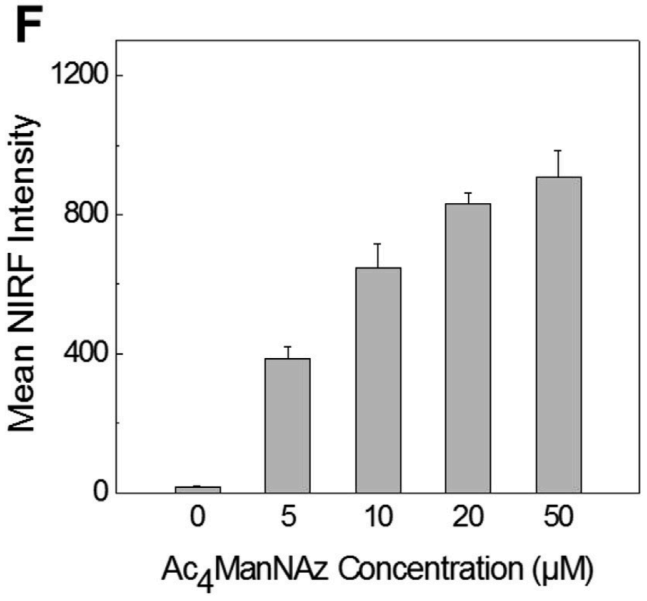
Stem Cell Labeling and Tracking







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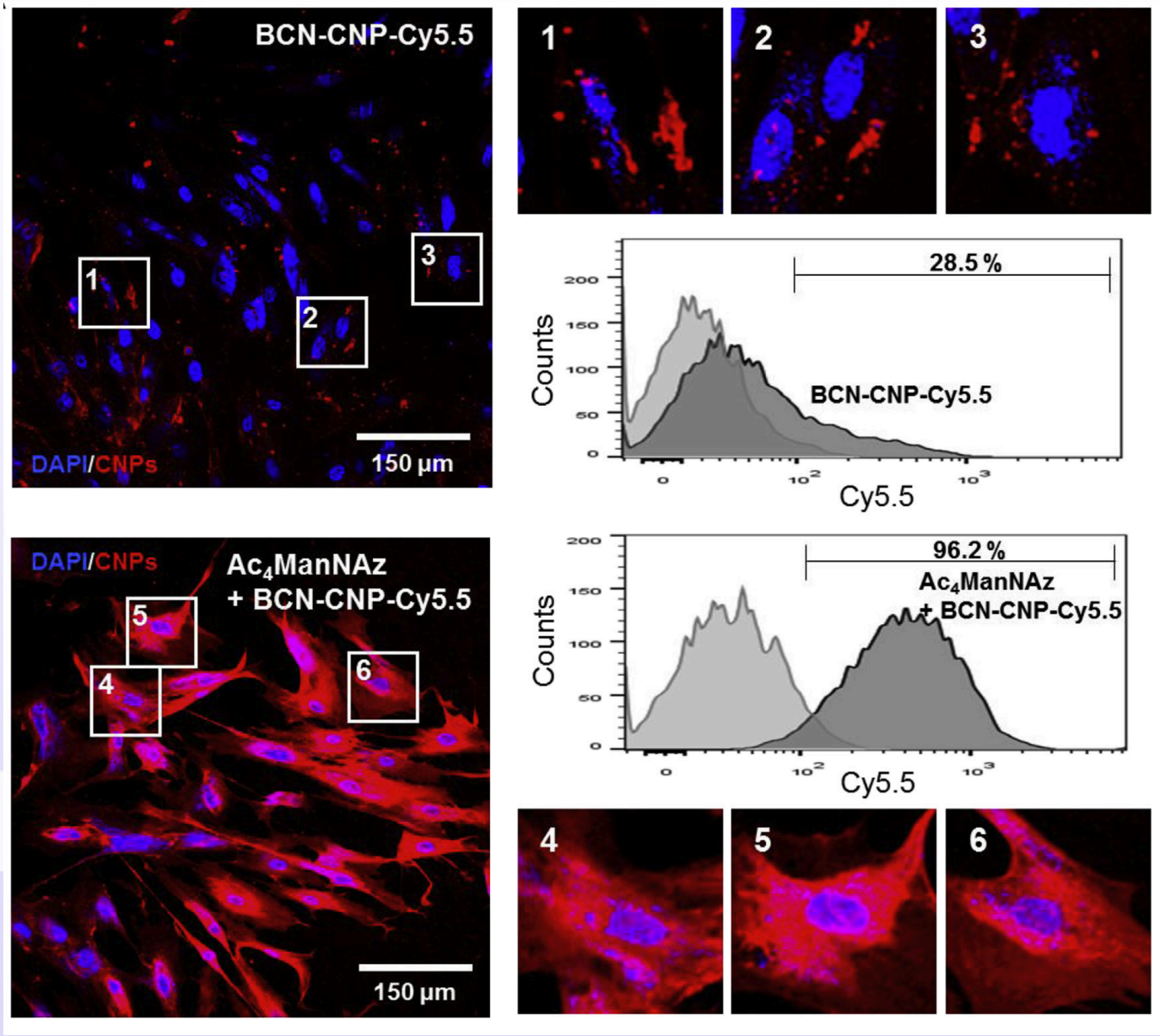
Stem Cell Labeling and Tracking



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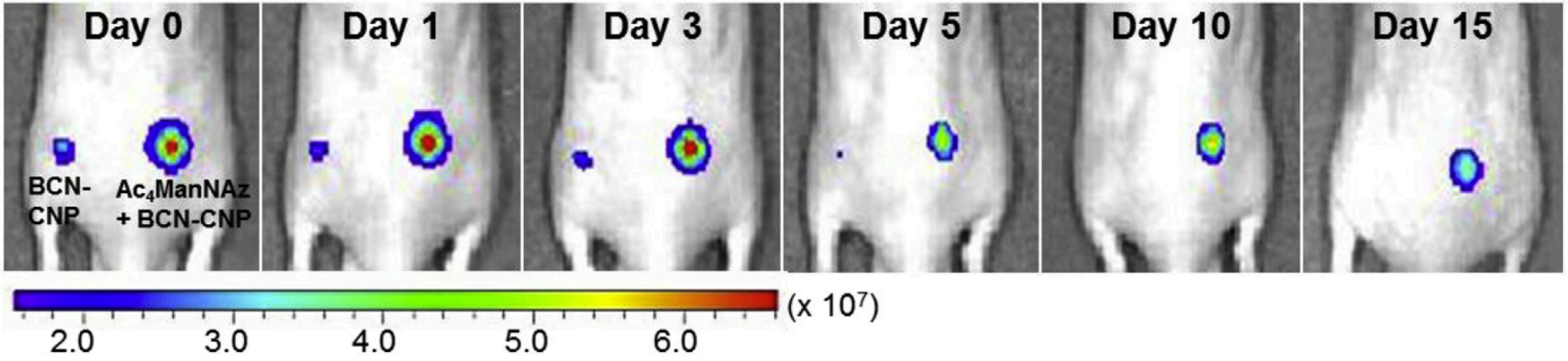
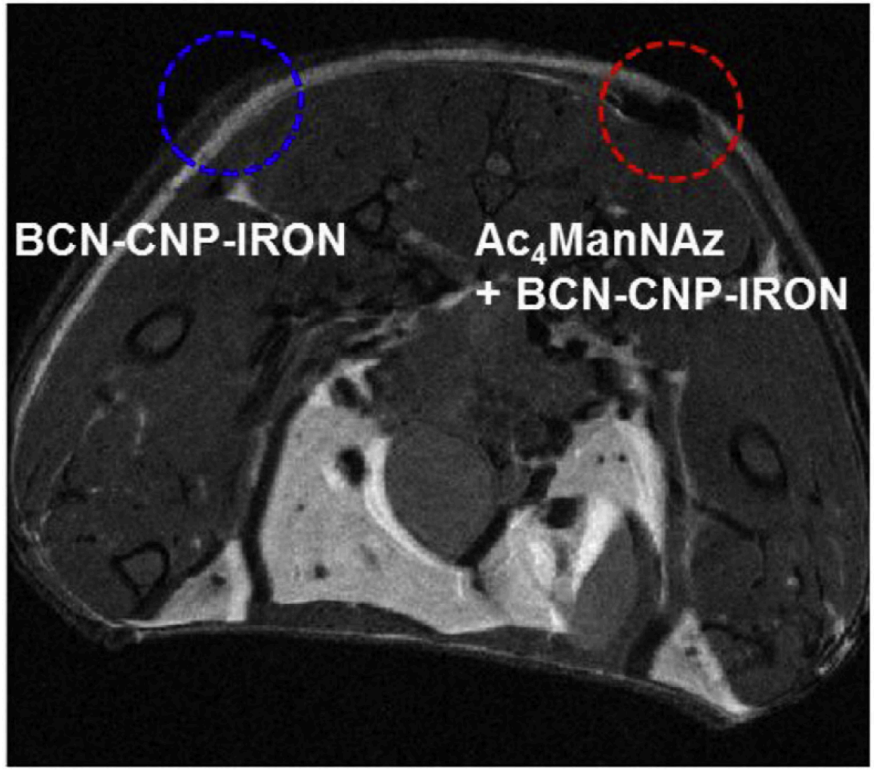
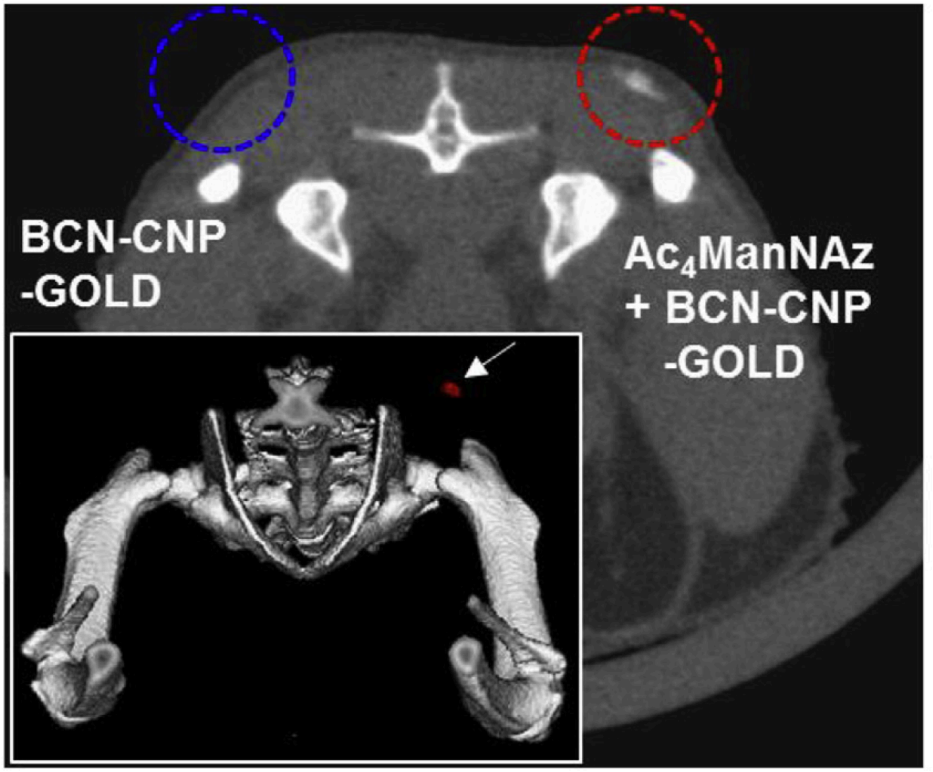
Stem Cell Labeling and Tracking







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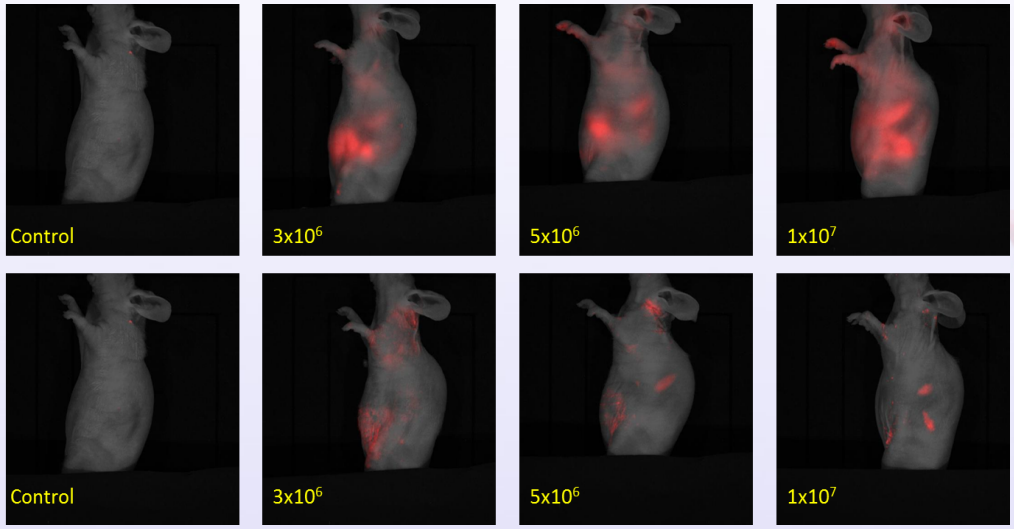
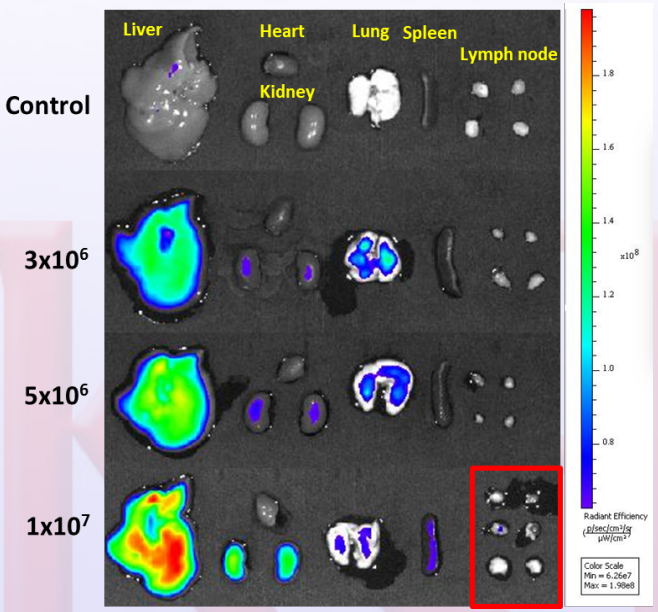
Biodistribution of Cy5.5 labeled splenocytes *in vivo*

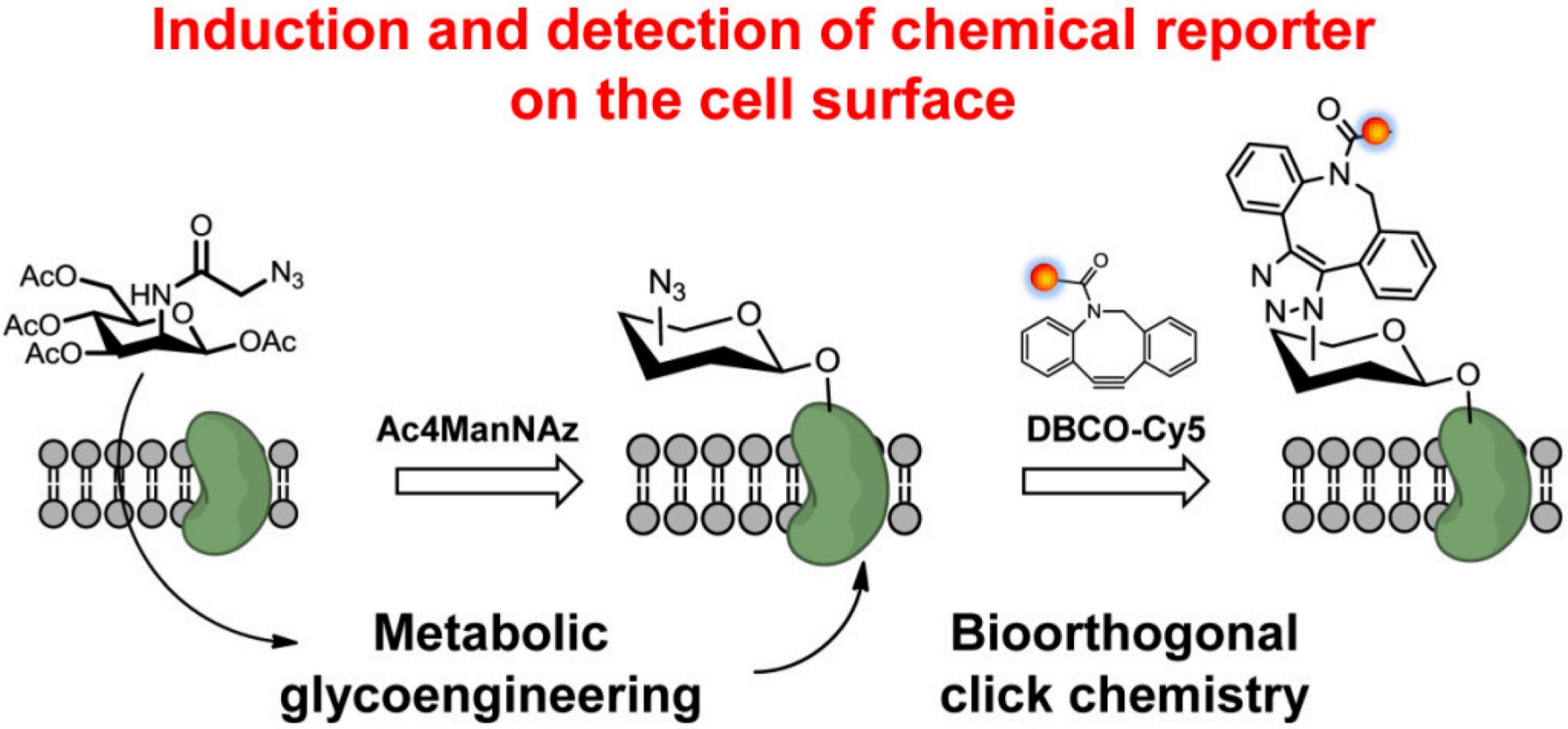
In vivo T-cell distribution (without Tumor)



Ex vivo T-cell distribution



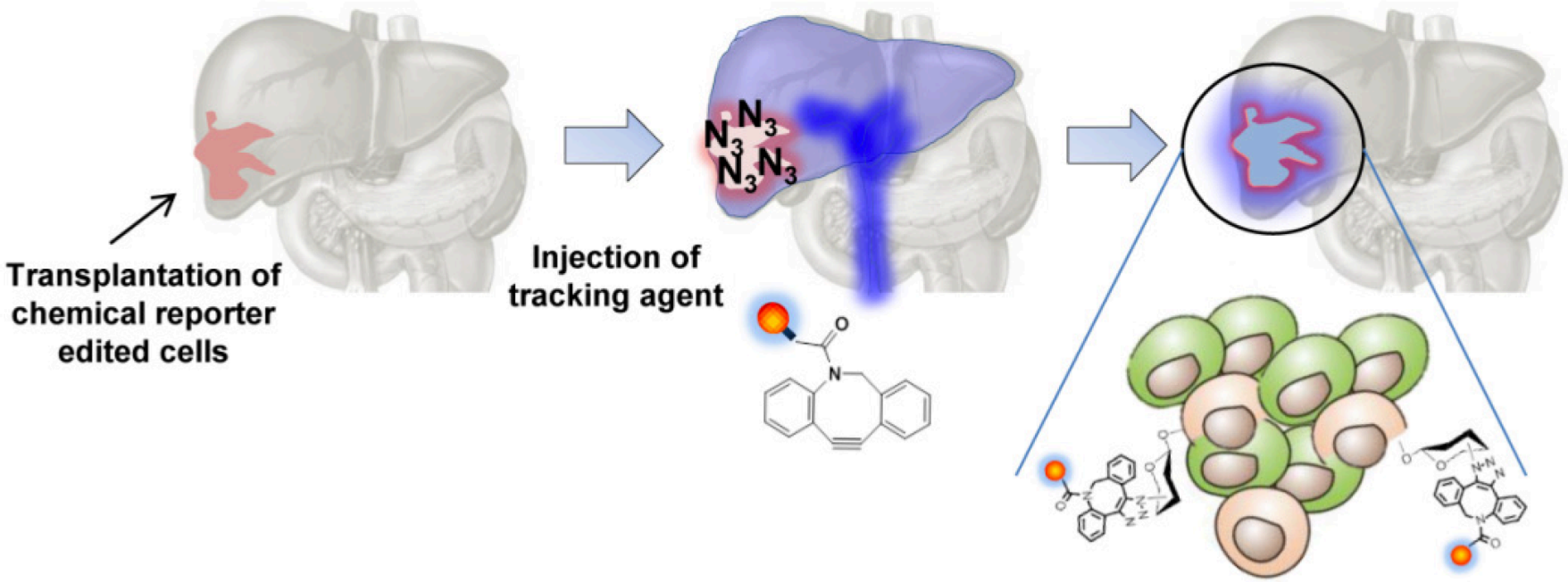
Cell Labeling and Tracking



SW. Kang et al. / Theranostics, 14 (2014) 420-431

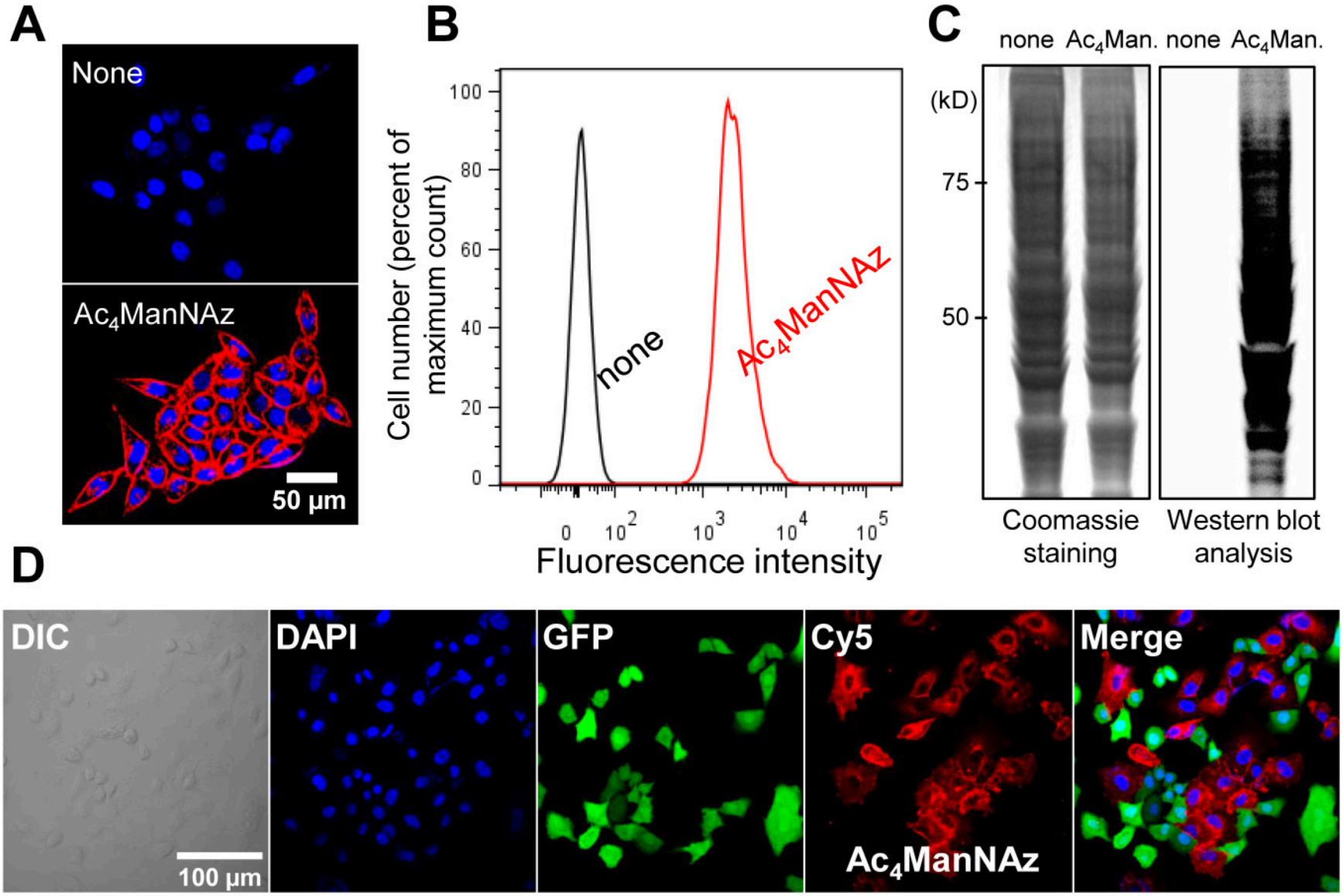
Cell Labeling and Tracking

Chemical reporter edited cell tracking in vivo



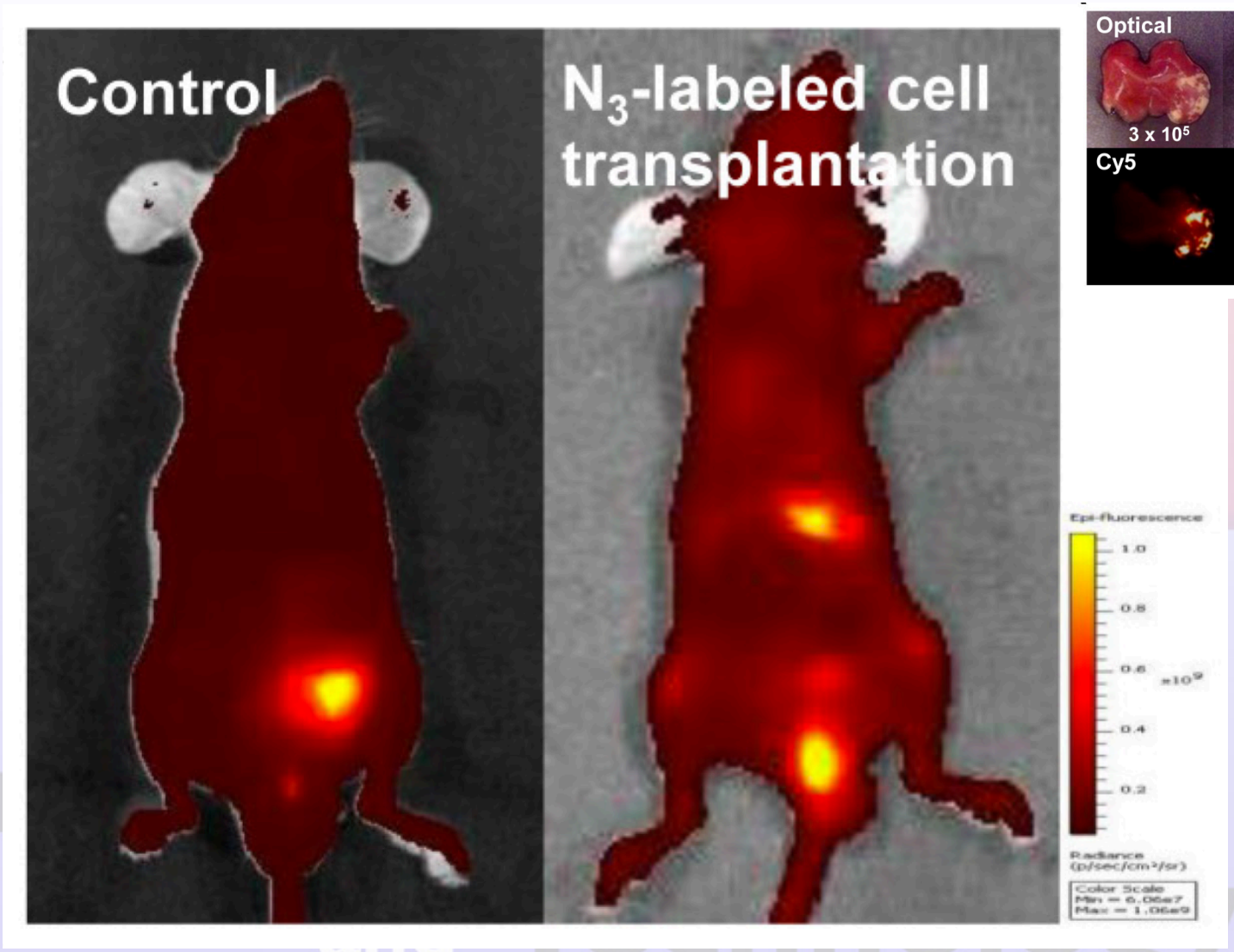
SW. Kang et al. / Theranostics, 14 (2014) 420-431

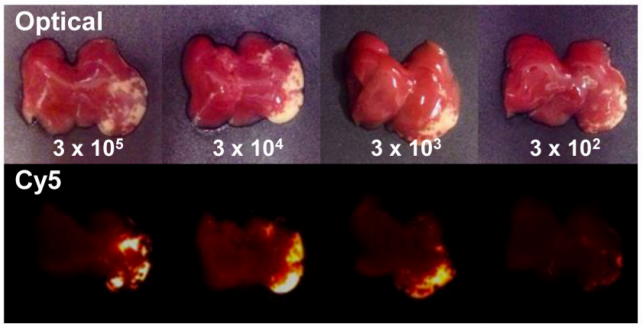
Cell Labeling and Tracking



SW. Kang et al. / Theranostics, 14 (2014) 420-431

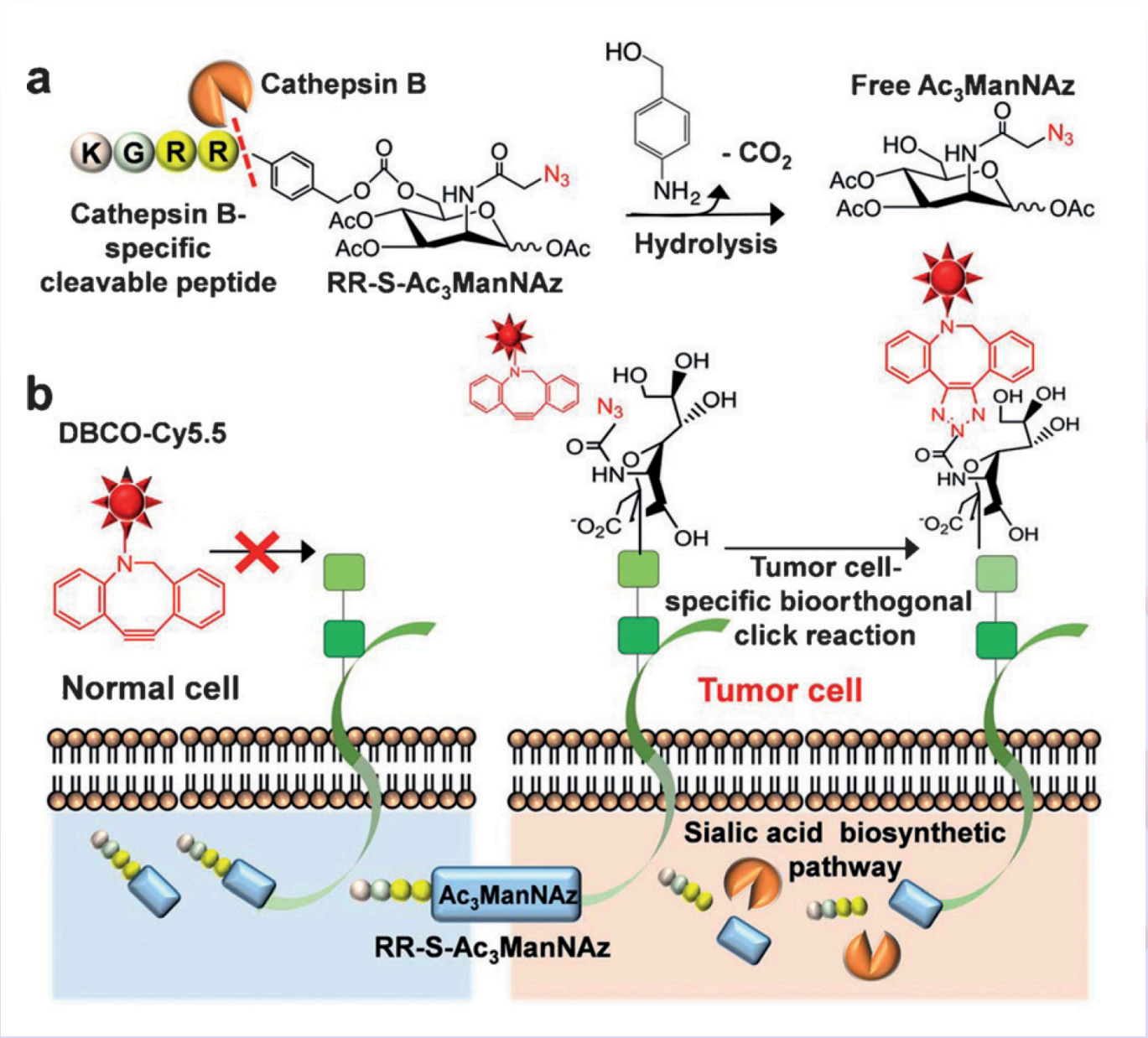
Cell Labeling and Tracking





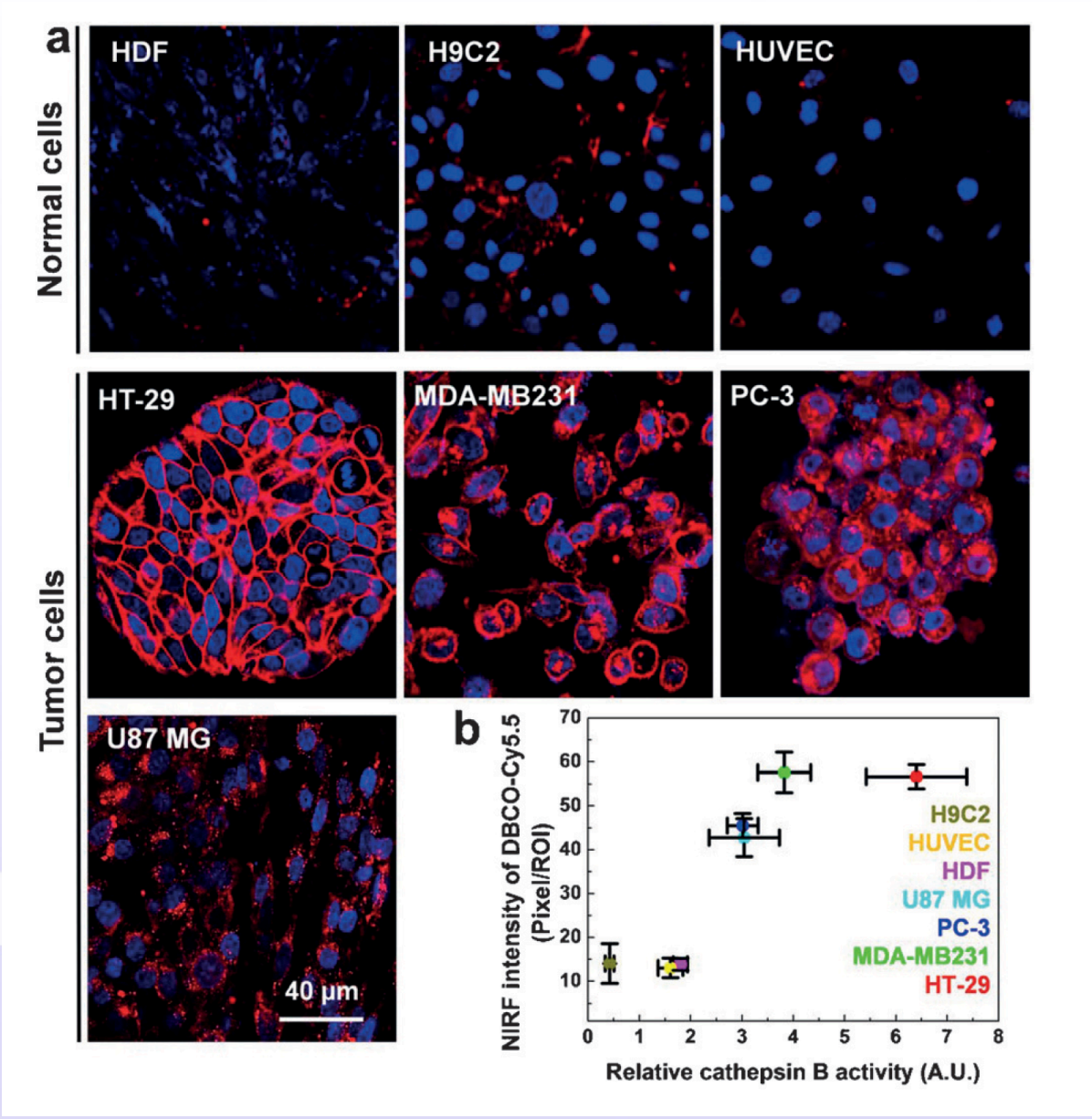
SW. Kang et al. / Theranostics, 14 (2014) 420-431

Enzyme Specific Cell Labeling



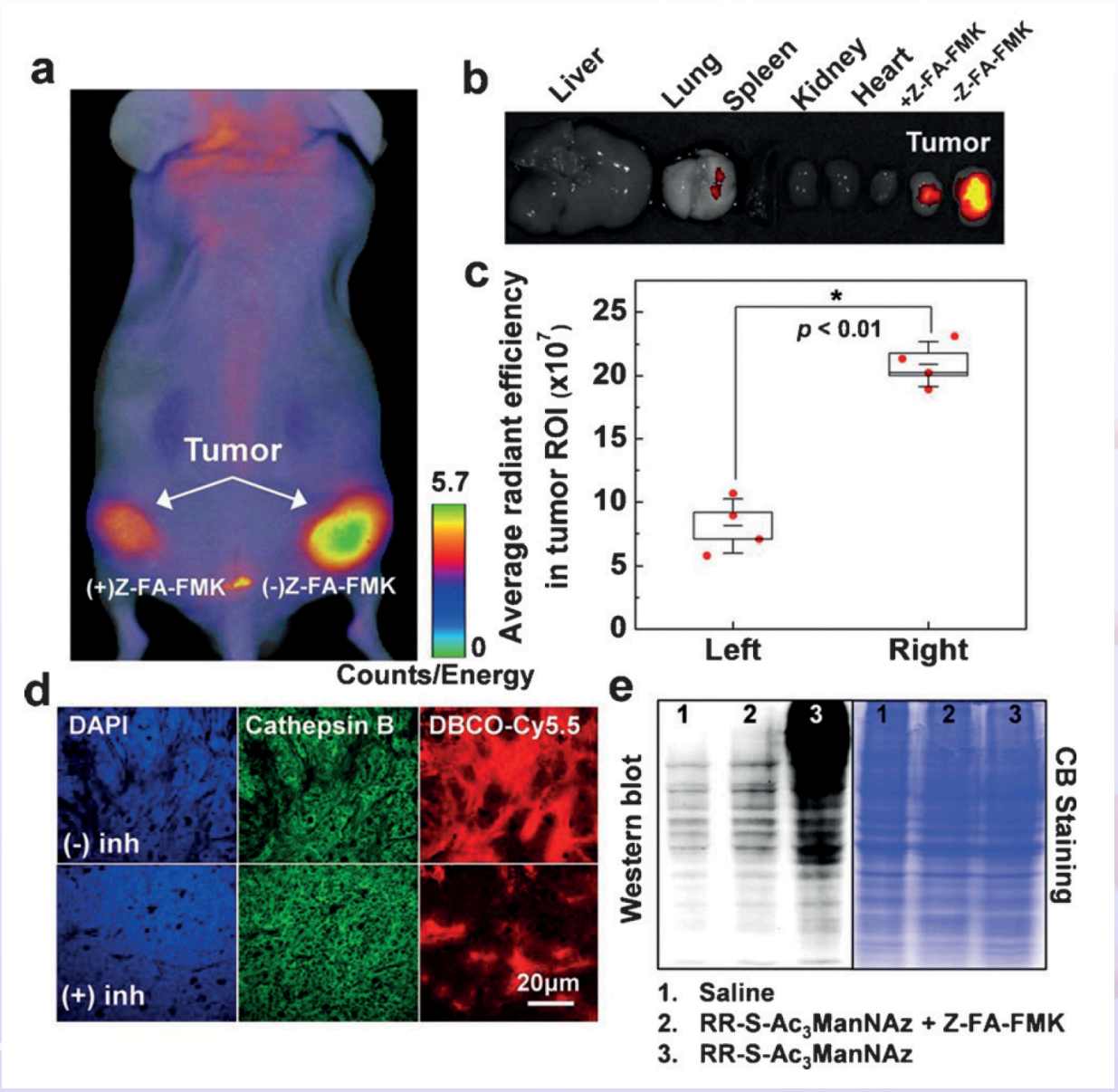
MK. Shim et al. / Angew Chem Int Ed, 55 (2016) 14698-14703

Enzyme Specific Cell Labeling



MK. Shim et al. / Angew Chem Int Ed, 55 (2016) 14698-14703

Enzyme Specific Cell Labeling



MK. Shim et al. / Angew Chem Int Ed, 55 (2016) 14698-14703

Thank You !

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KIST "Intramural Research Program"
MOST "Real Time Molecular Imaging"