How to Assess Biological Activity of Inflammarory Plaque?: Combined OFDI-NIRF Molecular Imaging

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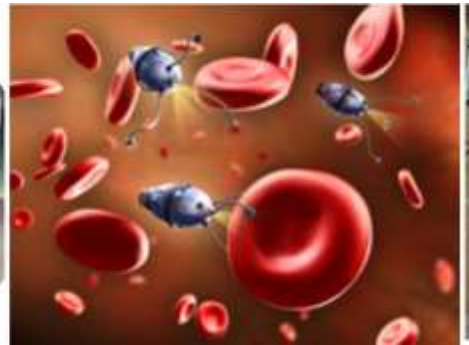
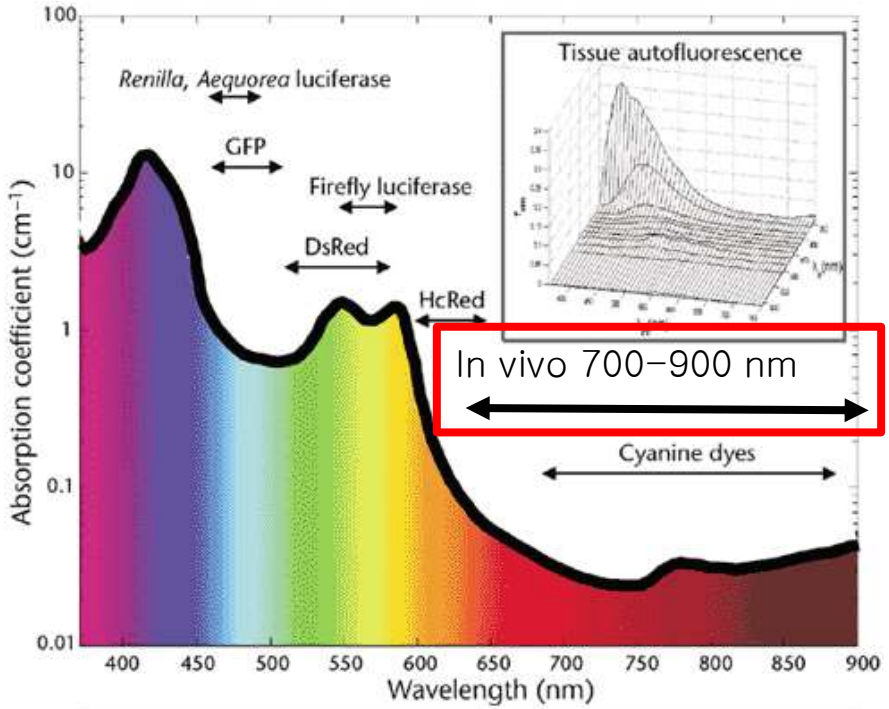
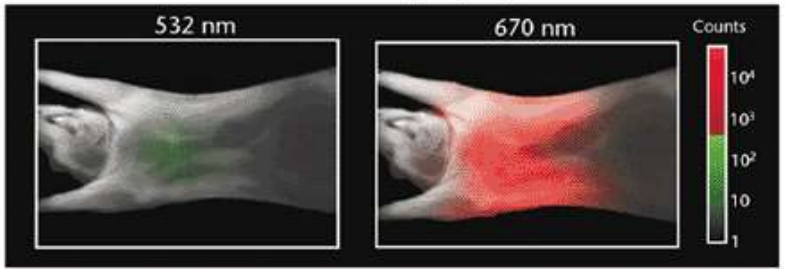
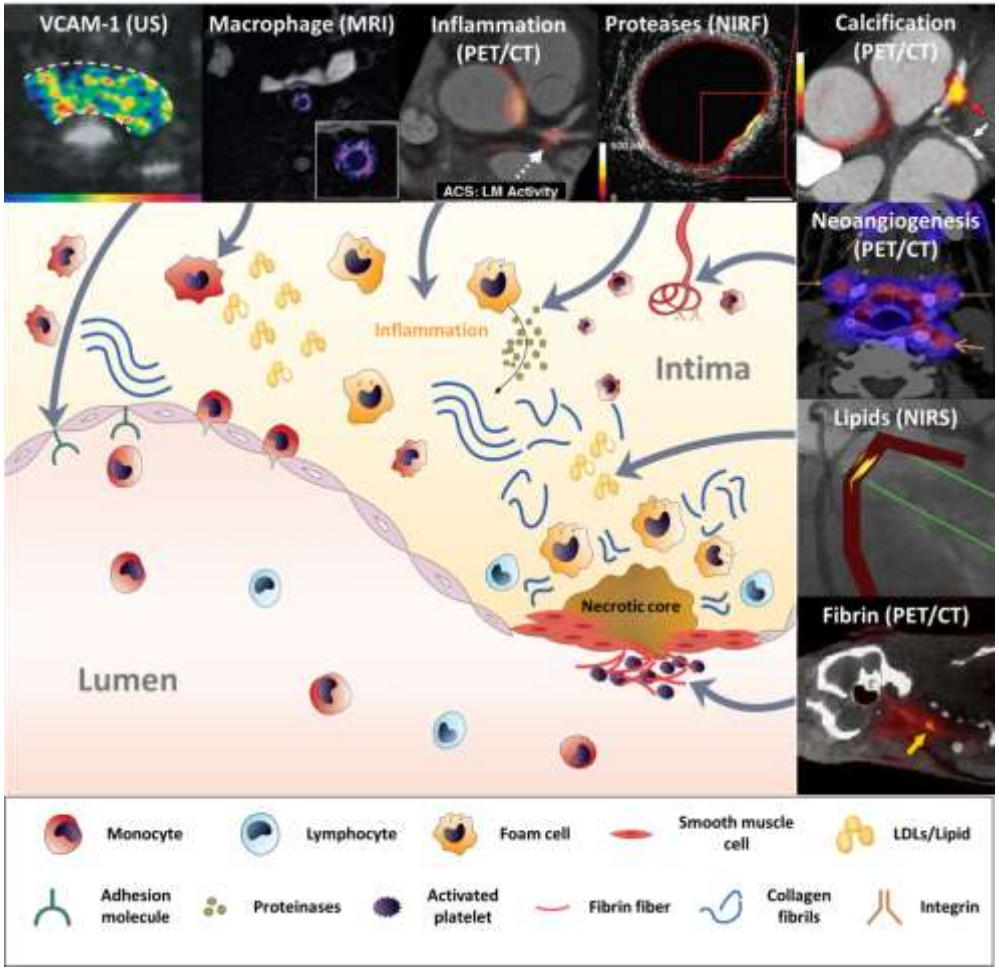


MOLI with Near-infrared Fluorochrome (NIRF)

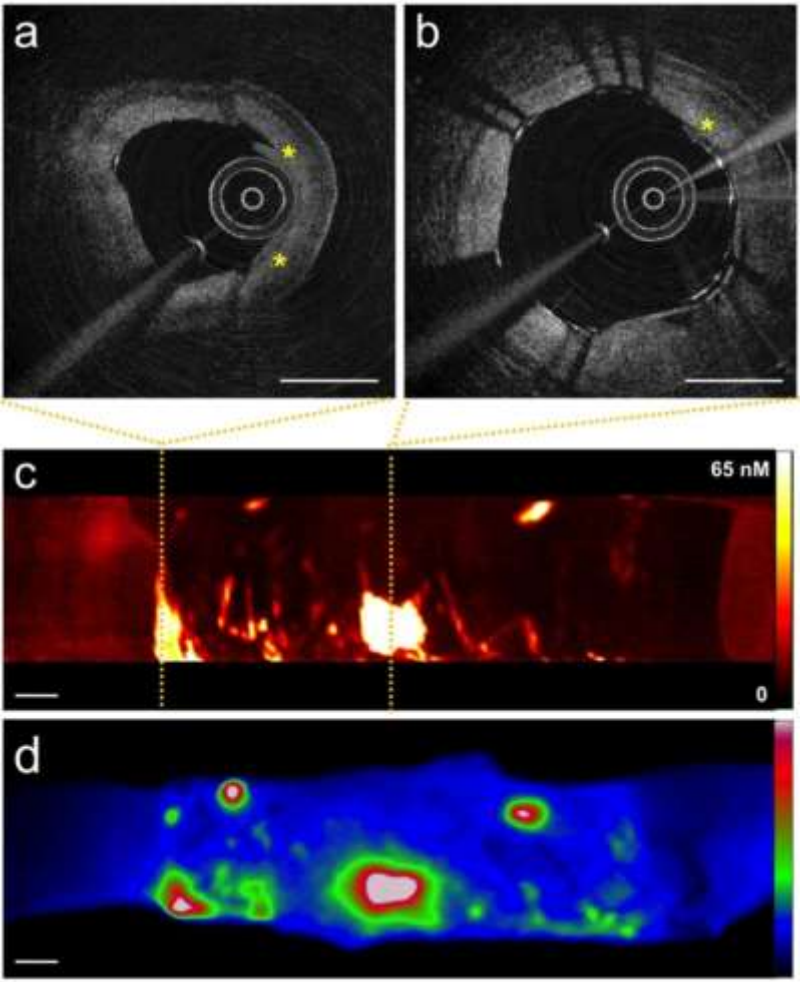




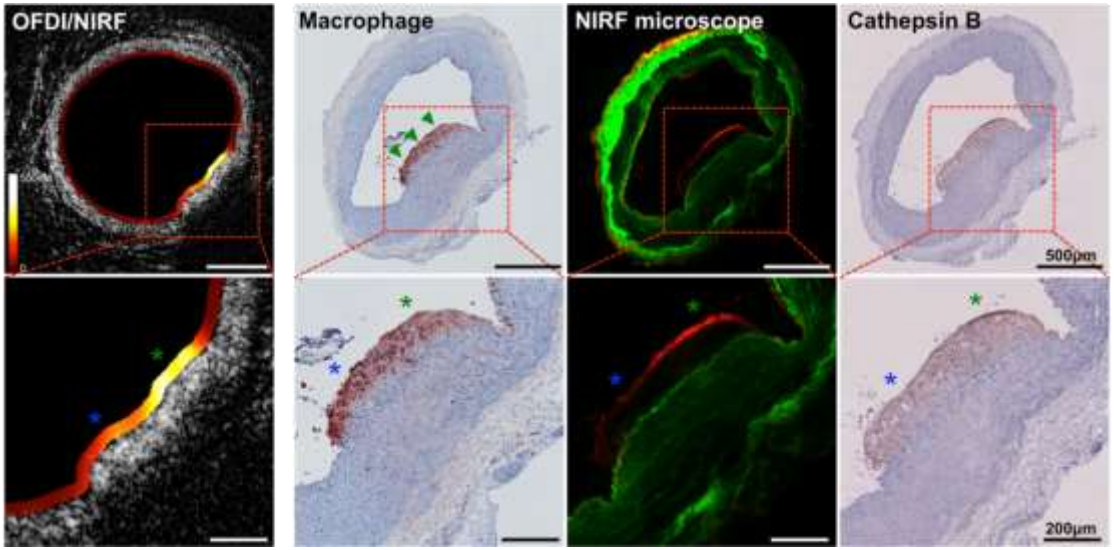


Lee SK, Kim JW. CCIR 2015

Fully Integrated OCT-NIRF Catheter



Fibrin-Targeting
Stent Thrombosis



Plaque Protease

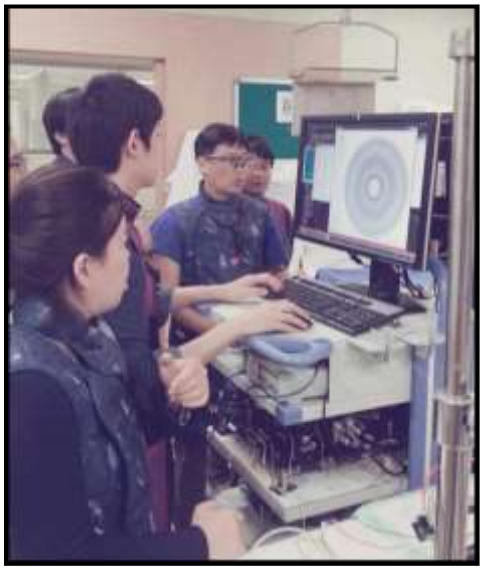
NIRF Probe Safety?
Blood Elimination?

Kim JW et al. Nature Medicine 2011

High-Speed 2nd Generation OCT-NIRF

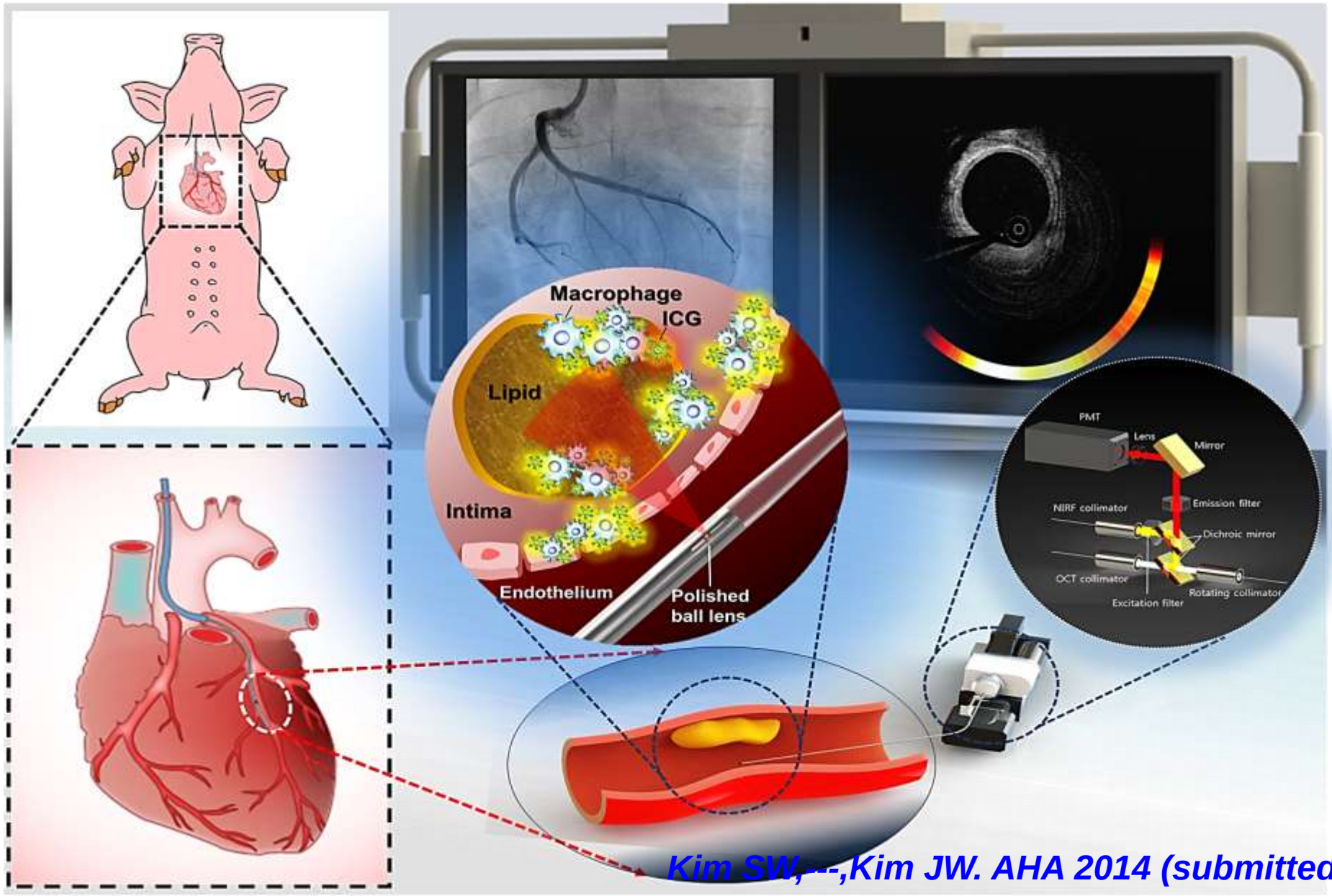
Real-time data acquisition of OCT-NIRF

- **Rotation speed: upto 100 rps**
- **Blood elimination: just flushing**
- **Pullback speed: upto 40mm/s**
- **No crosstalk**
- **Real-time OCT-NIRF Synchronization**



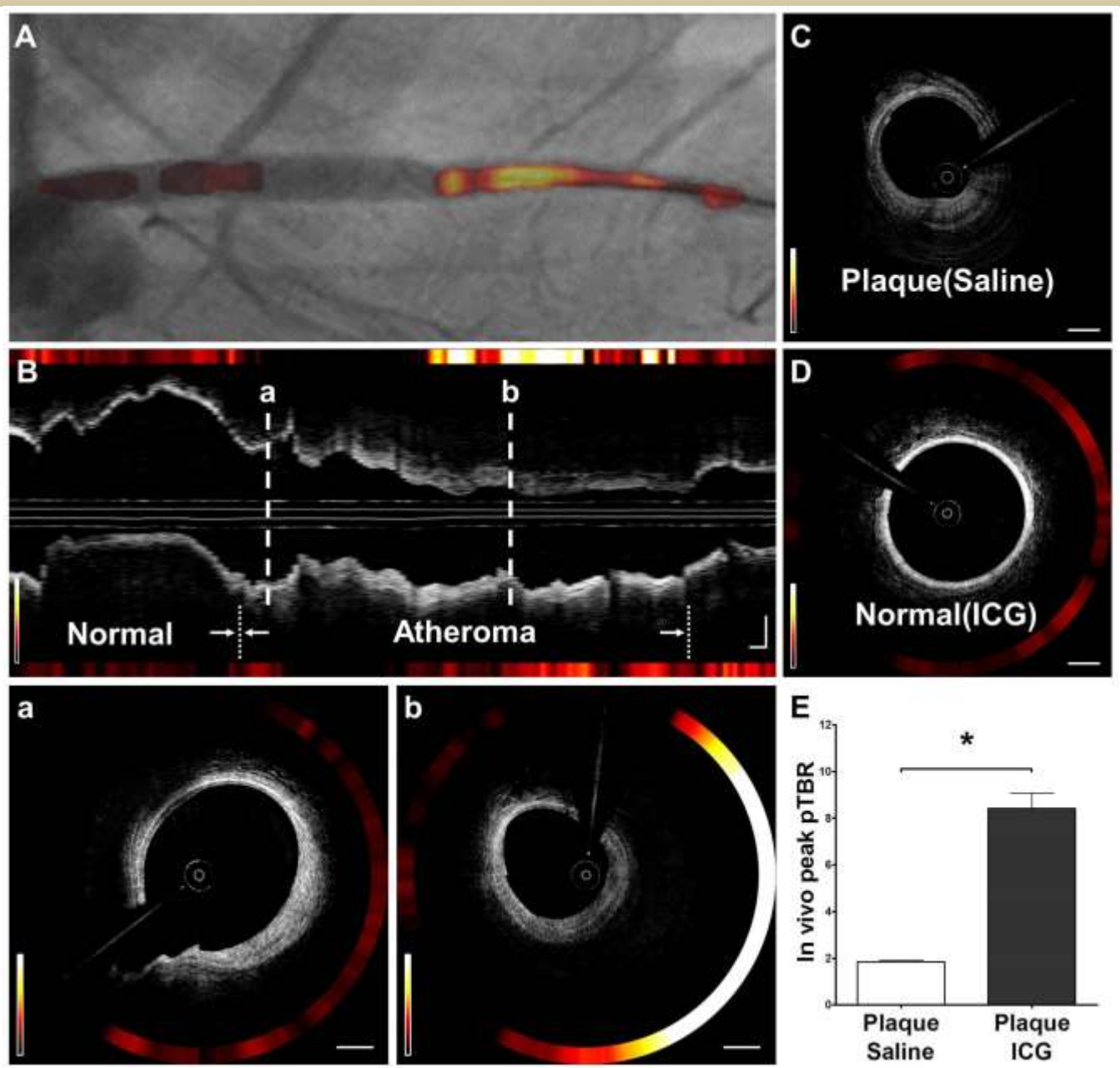
Circulation Cardiovasc Interv 2014

OCT-NIRF in a Beating Coronary Plaque

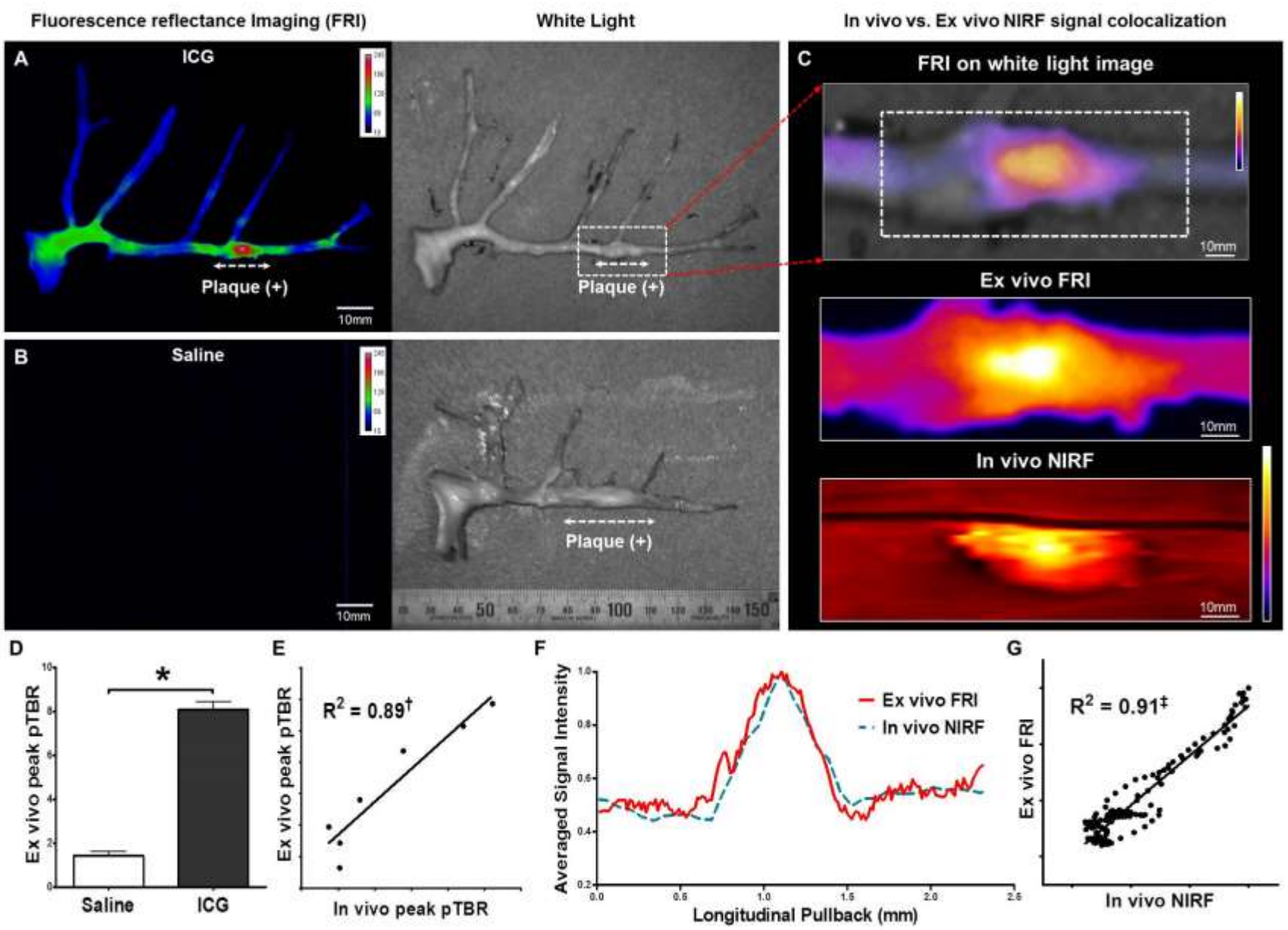


Kim SW,---,Kim JW. AHA 2014 (submitted)

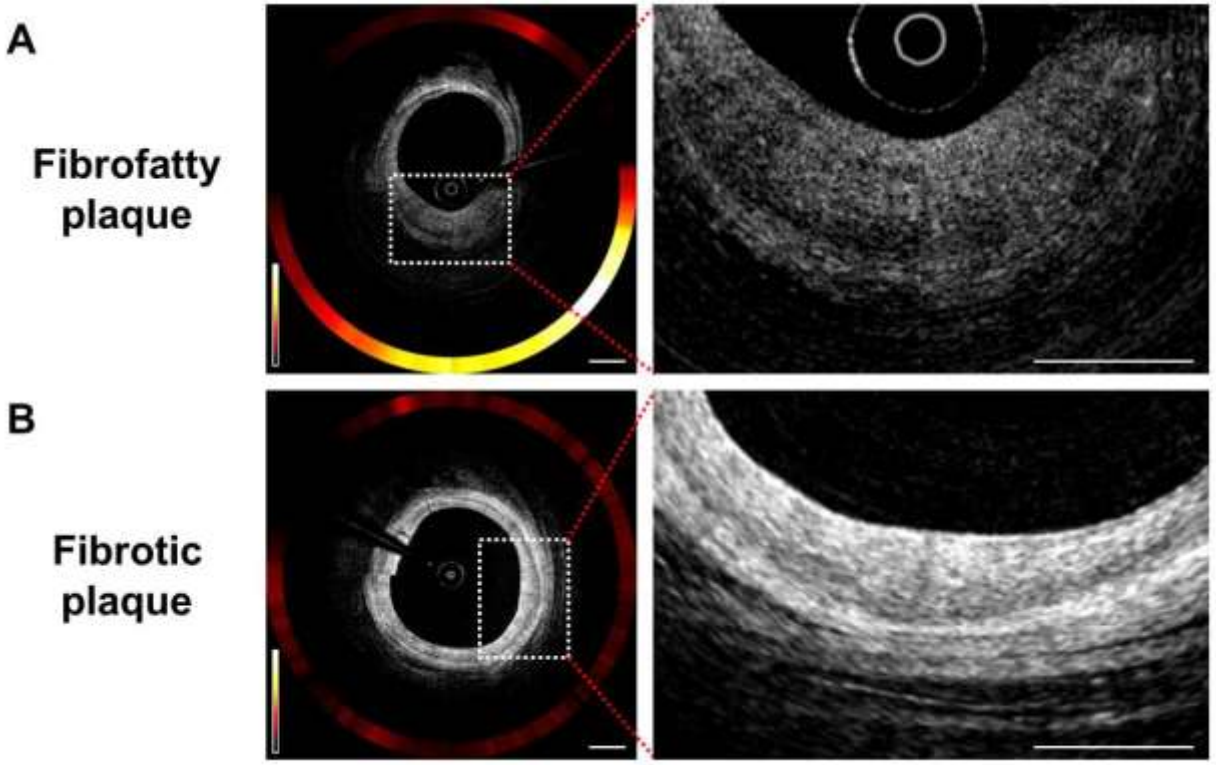
In Vivo OCT-NIRF

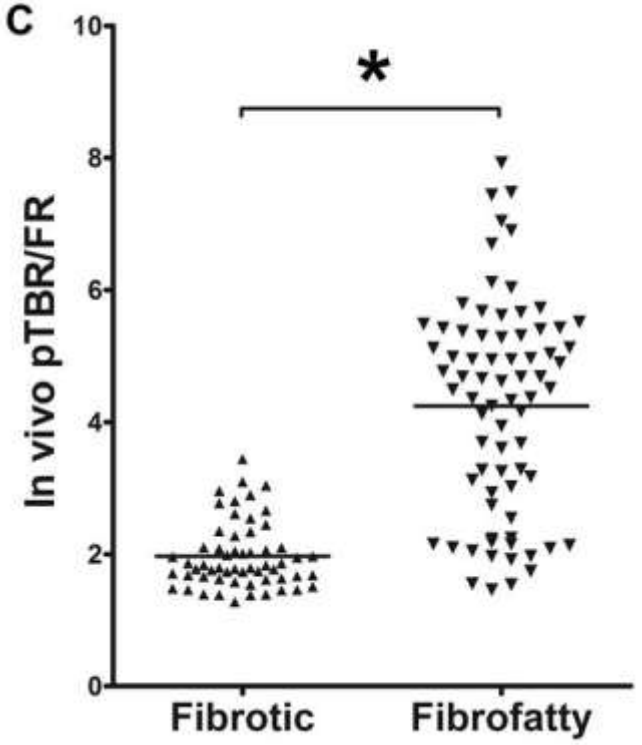


Ex Vivo Validation

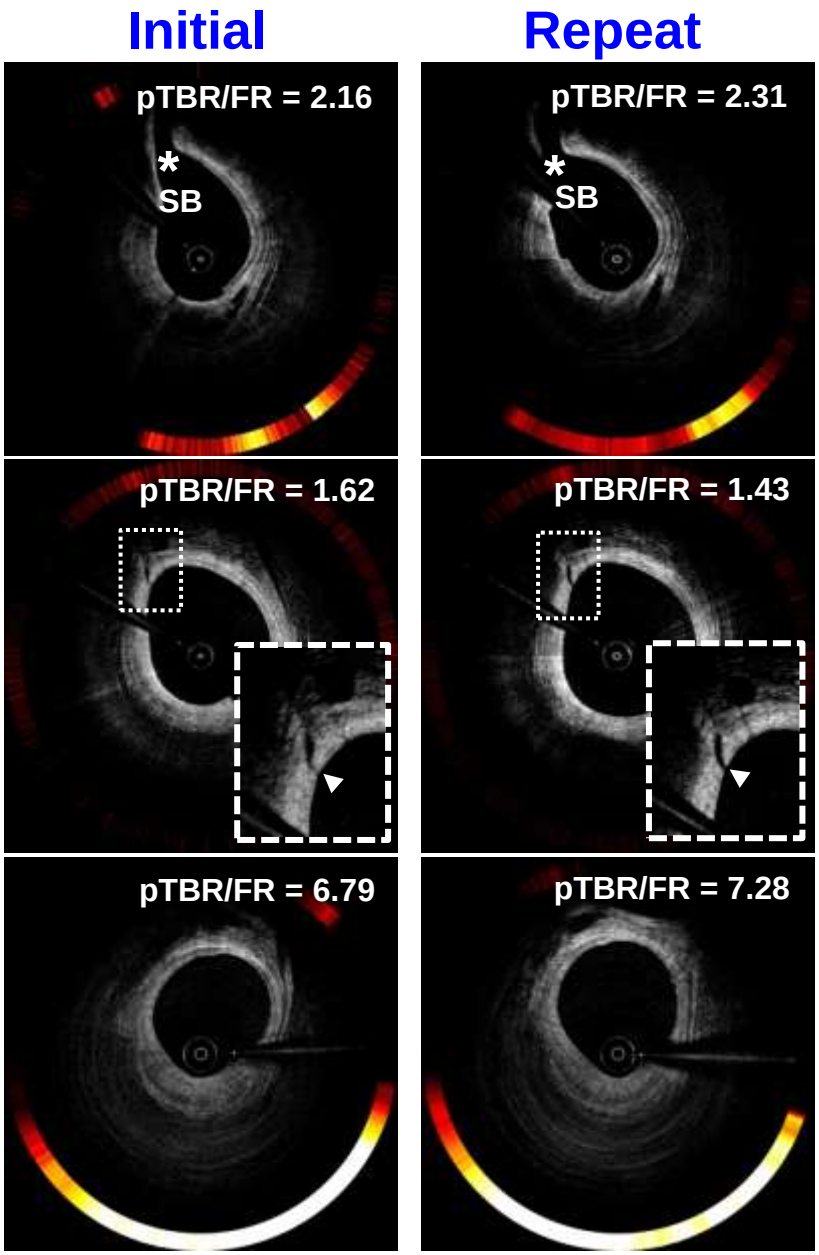


NIRF - Plaque Type



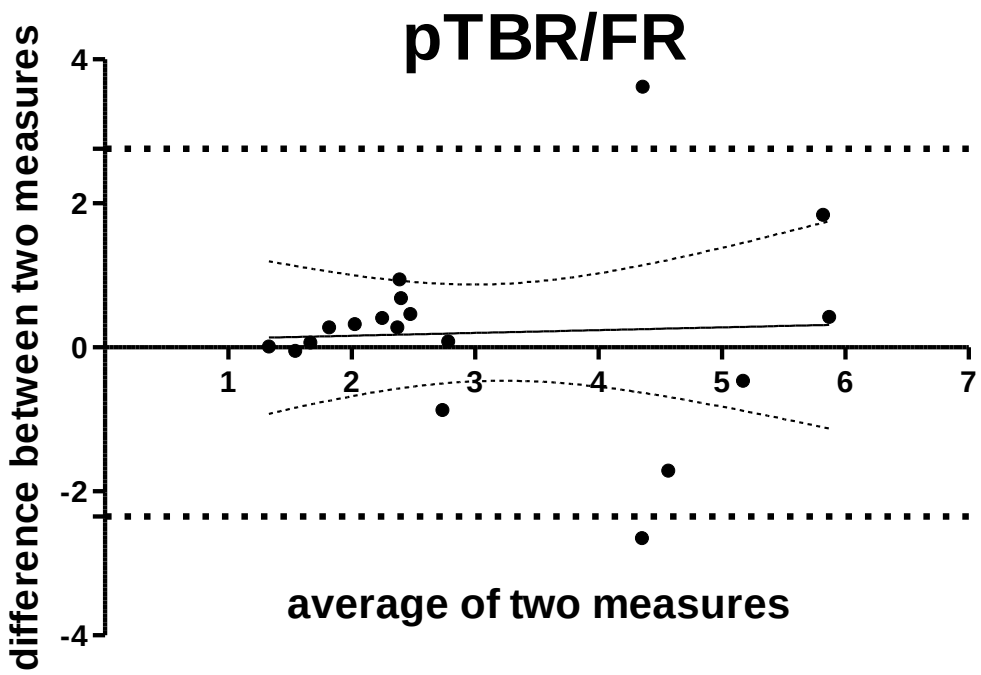


Excellent Reproducibility



ICC = 0.823 (82.3% consistency)

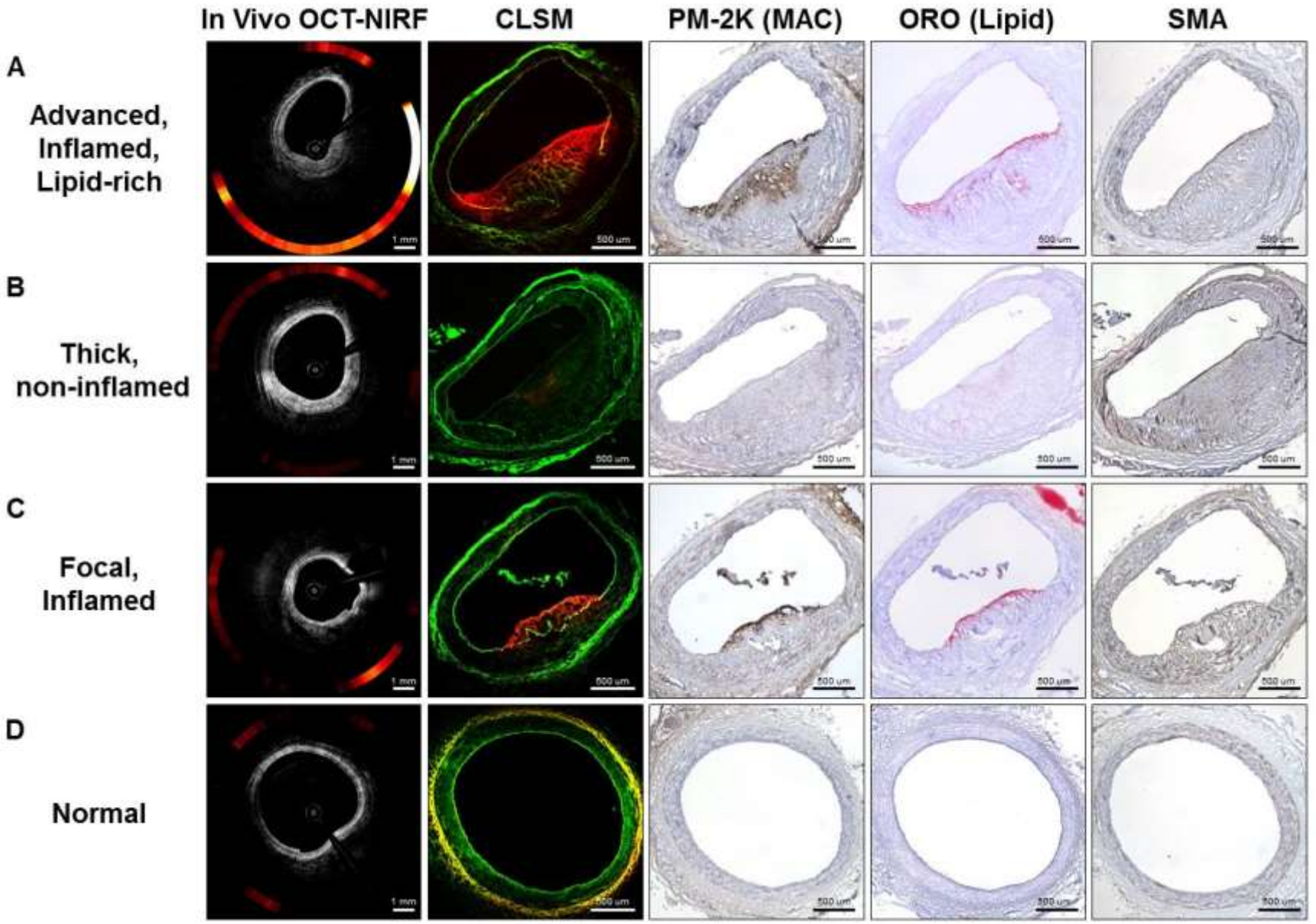
p < 0.001



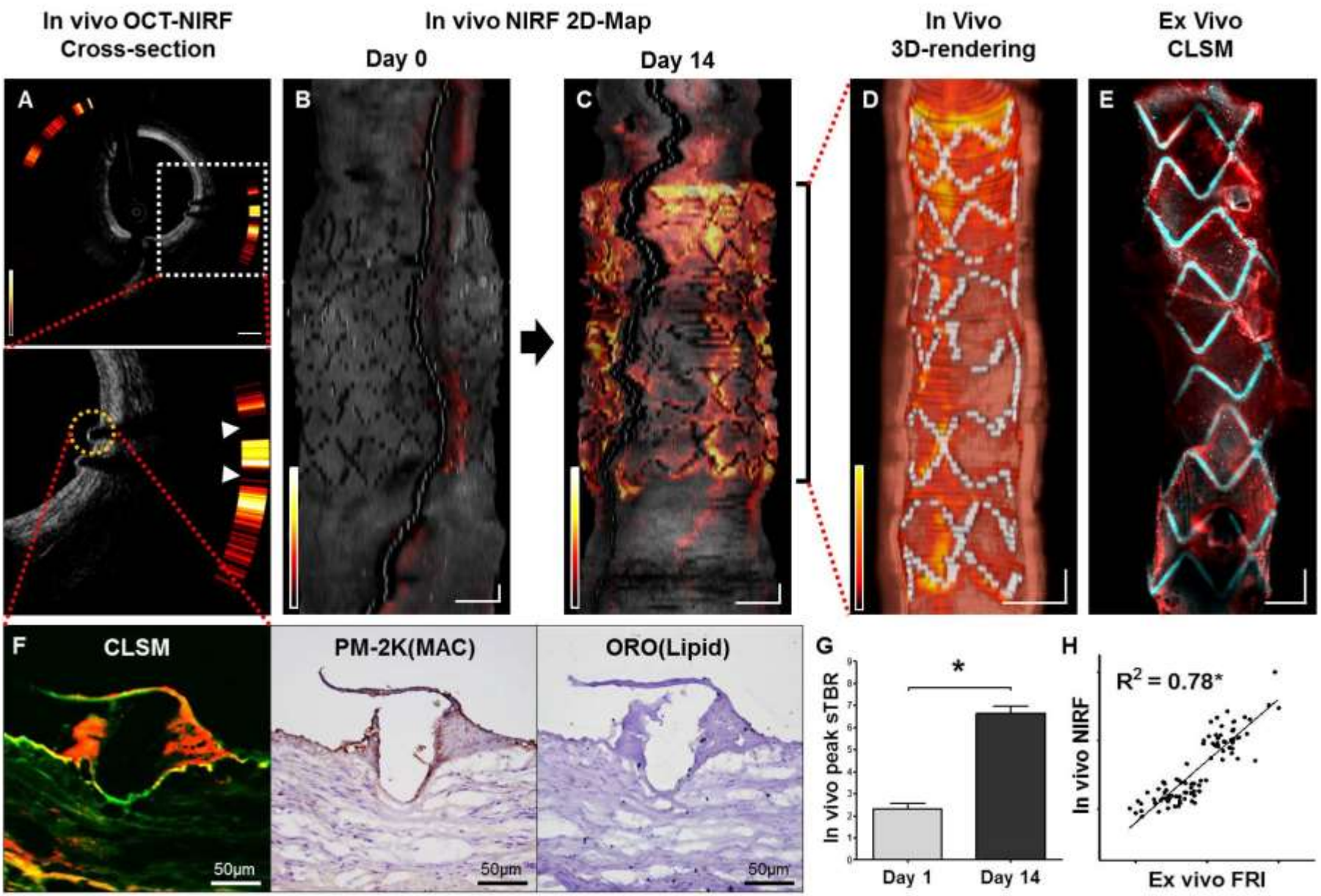
Bland-Altman Plot

ICC = Interclass Correlation Coefficient

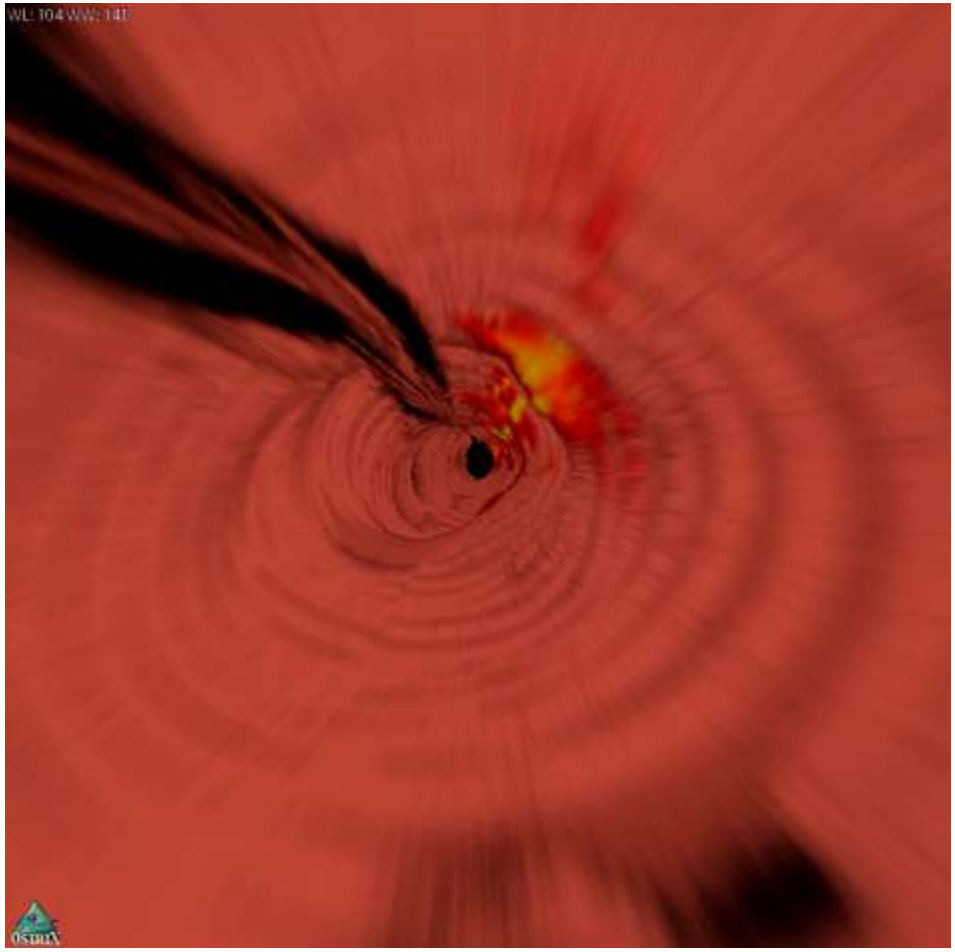
Corroborrative Immunostaining

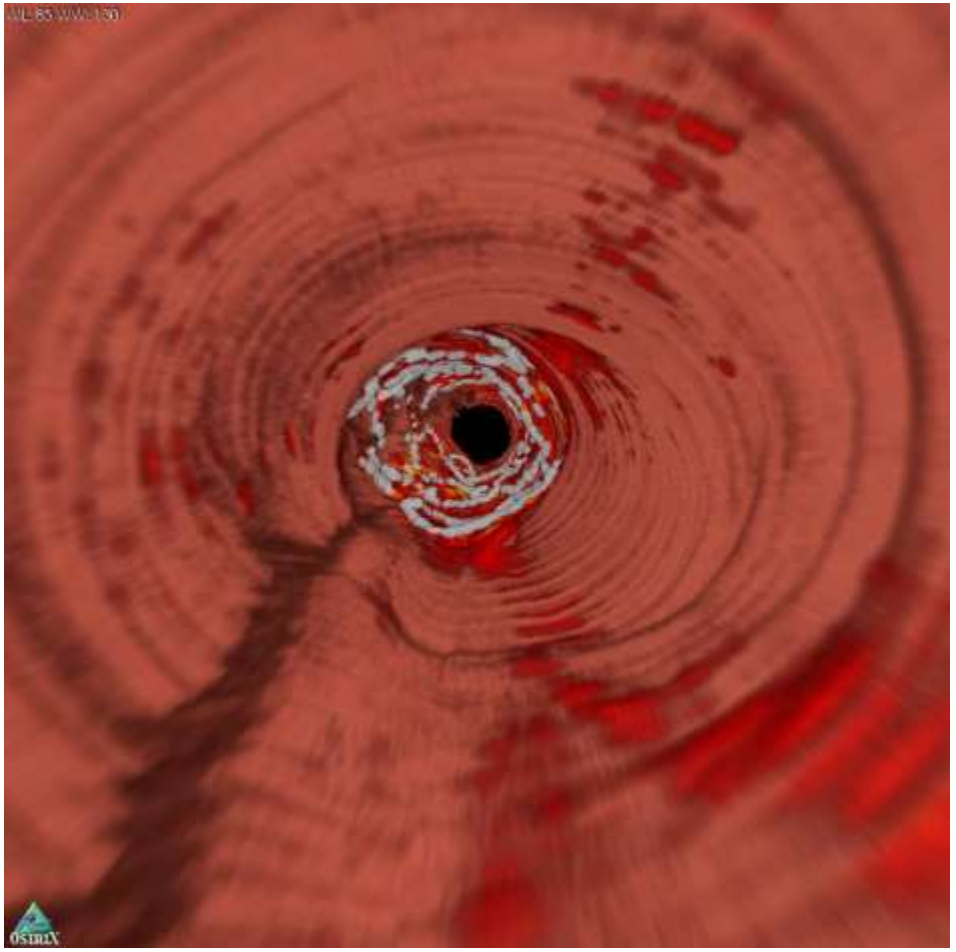


DES-associated Inflammation



Coronary OCT-NIRF Imaging *In Vivo*





Vulnerable Plaque

DES related inflammation

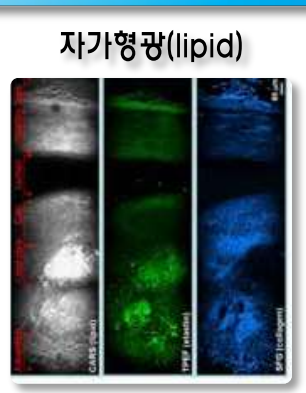
Clinical Trial Roadmap Launching

Preclinical

1st Human Trial

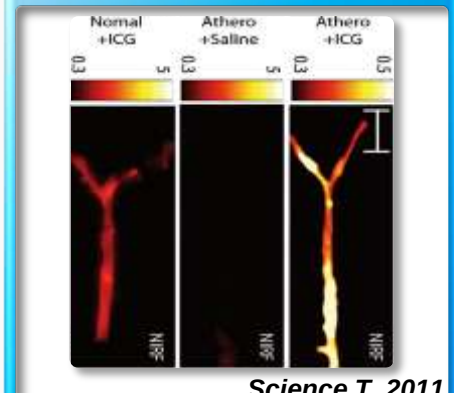
1 Autofluorescence

- Necrotic core signal
- Escape of nanoprobe



2 Macrophage Nonspecific

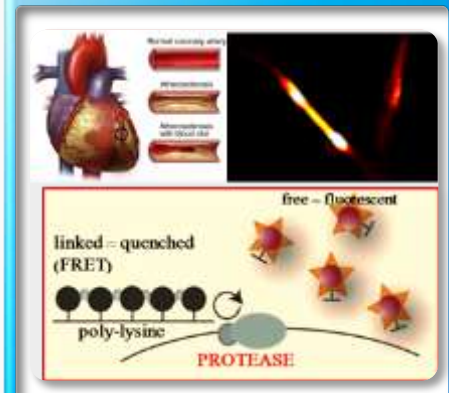
- ICG fluorochrome
- Validated human safety



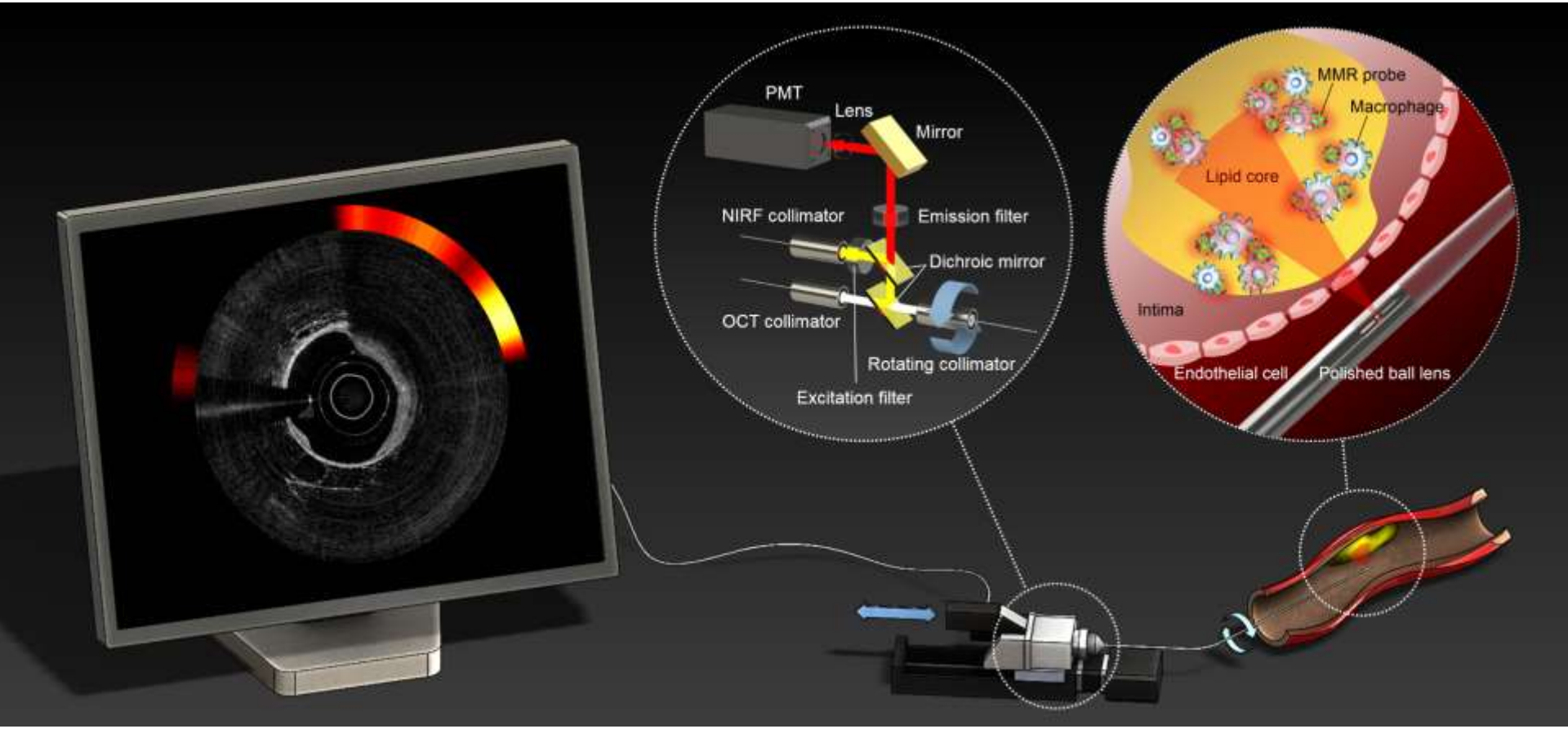
Science T. 2011

3 Specific targeting

- Prosense VM 110
- Chitosan NIRF

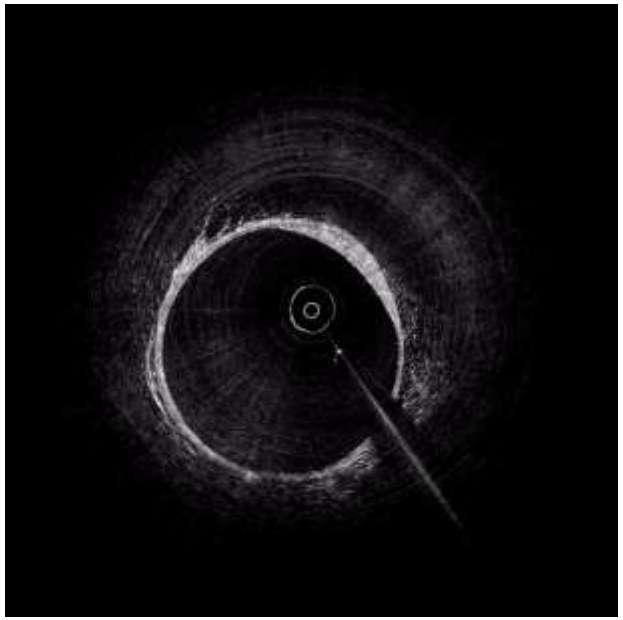


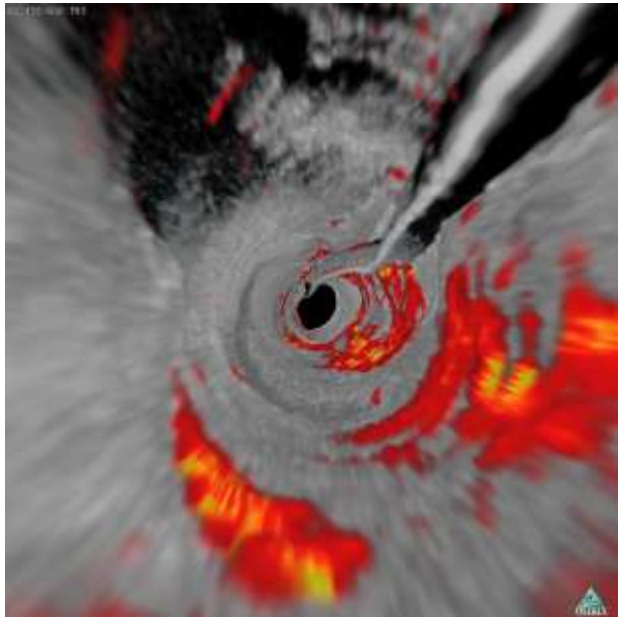
Targeting Strategy with a Novel Optical Probe

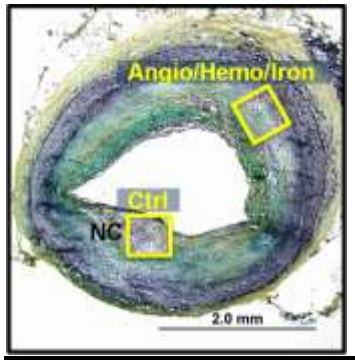


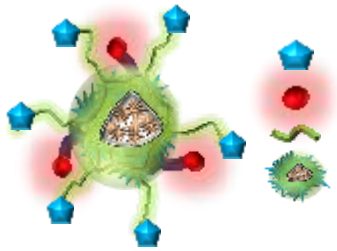
JB Kim,---, Kim JW. AHA 2014. (submitted)

High-risk Plaque Mac Subset Imaging

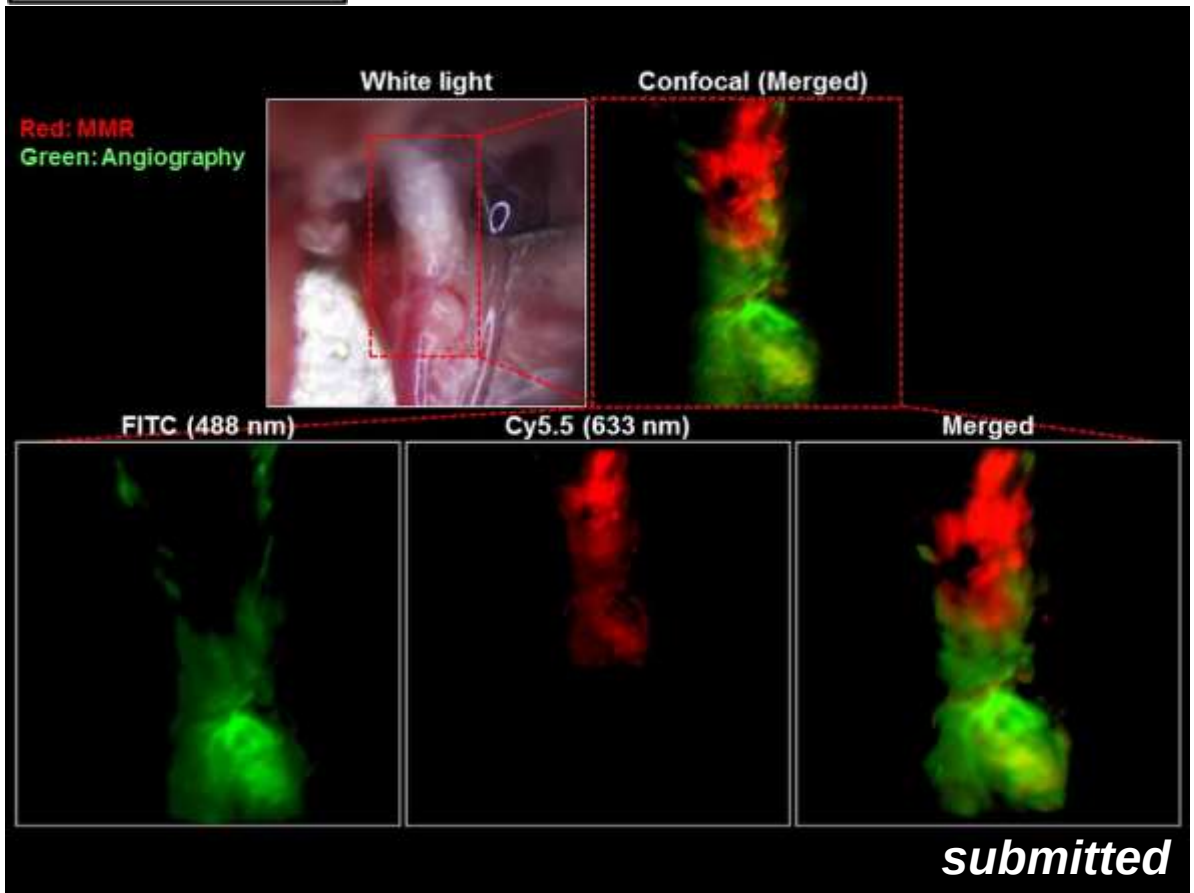




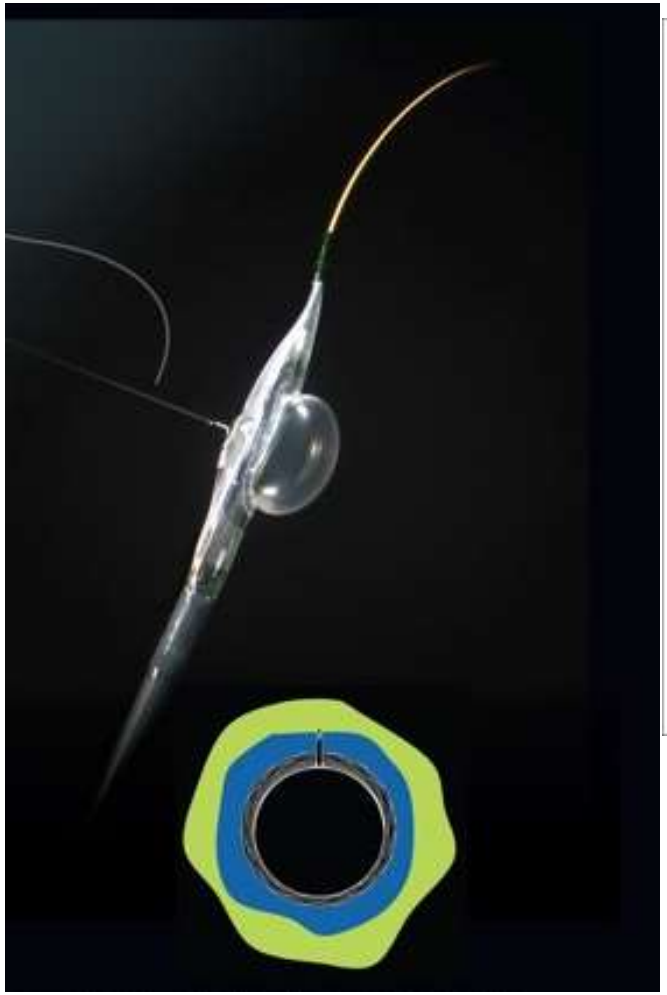


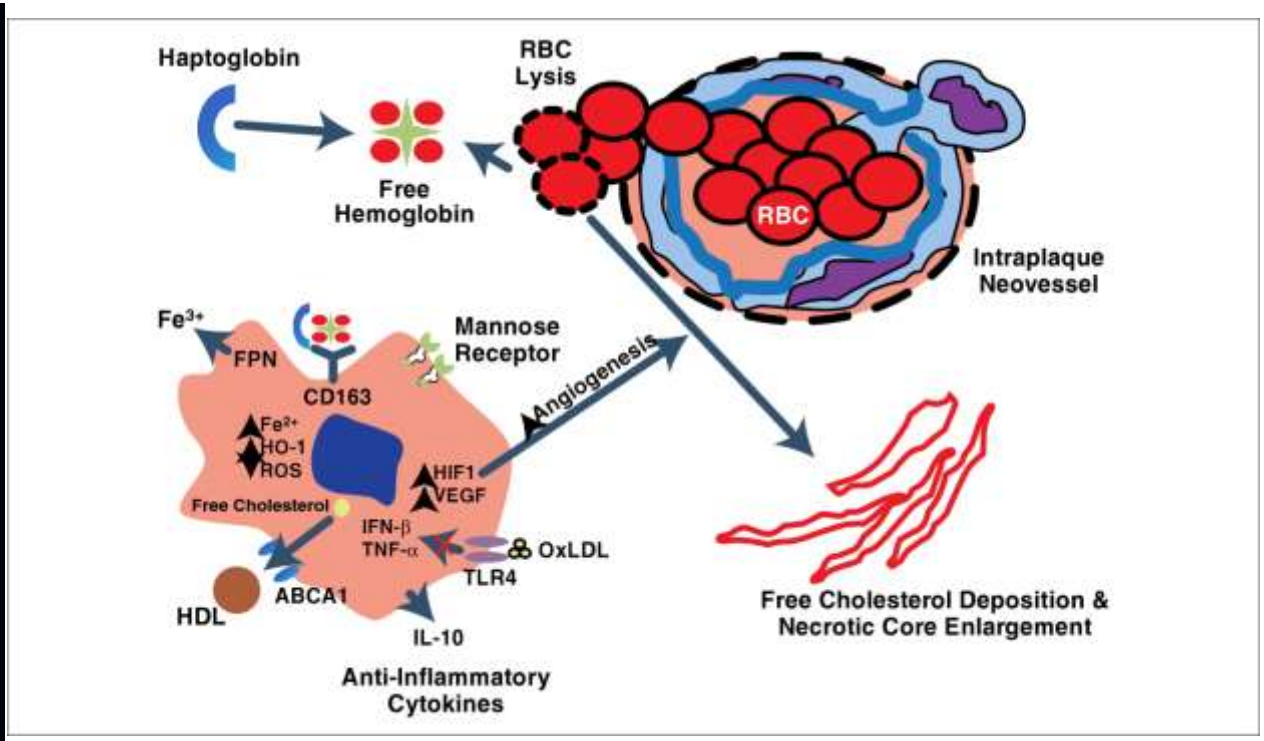


Mannose receptor binding ligand
NIRF dye (Cy5.5 or 7)
PEG
Glycol chitosan nanoparticle



In Vivo Plaque MMR MOLI
IPH May Modify Macrophage Subset Behavior?





OCT-Label Free FLIM Imaging

OCT–FLIM

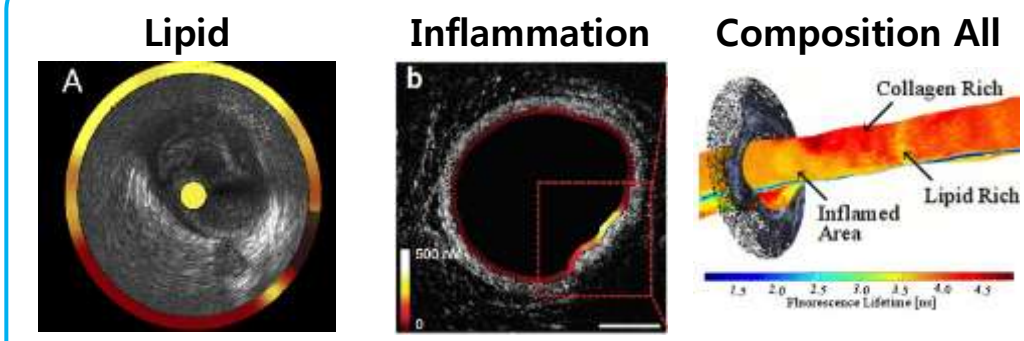
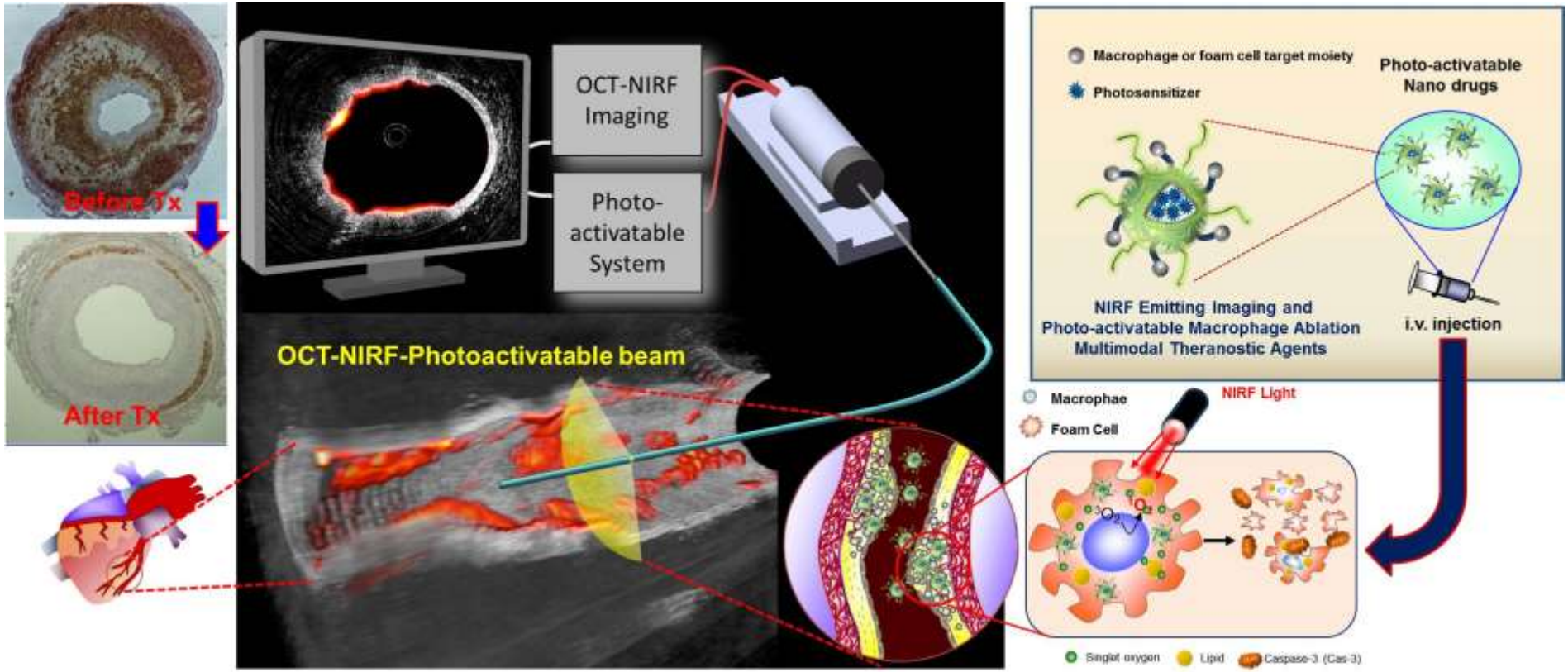


Table 1 Comparison between Intravascular Imaging Techniques

	X-ray angio.	IVUS	OCT	IVUS-NIRS	OCT-NIRF	**OCT-FLIM**
Resolution	+	++	+++	++	+++	**+++**
Speed	+++	+	+++	+	+++	**+++**
Lumen area	-	+++	+++	+++	+++	**+++**
TCFA	-	+	+++	++	+++	**+++**
Lipid plaques	-	+	+	+++	++	**+++**
Plaque burden	-	+++	+	+++	+	**+**
Thrombus	-	+	++	+	++	**+++**
Stent analysis	-	+	+++	+	+++	**+++**
Inflammation	-	-	+	-	+++	**+++**
Safety	+++	+++	+++	+++	+	**+++**

Samsung Research Funding Center for Future Technology

Personalized Theranostic Strategy



NRF Creative Research Initiative Program

Conclusion

- **A fully integrated OCT-NIRF imaging with a clinically approved NIRF enhancing ICG was able to accurately identify high-risk coronary plaque and assess DES-associated coronary inflammation.**
- **This highly translatable dual-modal, structural-molecular imaging strategy could enhance our capabilities to understand high-risk plaque biology and is expected to spur personalized approaches to estimate plaque vulnerability in near future.**
- **A newly developed, plaque macrophage targeting NIRF probe could be utilizable for high-risk plaque imaging, and needs to be further validated regarding acute toxicity and long-term safety.**

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