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Design of sensors for in-vivo detection of cancer related enzymes

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Background

- Cancer is among the leading causes of death in the world.
- In 2018, there were approximately 9.6 million cancer deaths.
- In the U.S. alone there were 1.7 million new cancer cases and 600,000 deaths.

T_1 and T_2 maging

Water T_1 and T_2 measurements (600MHz)

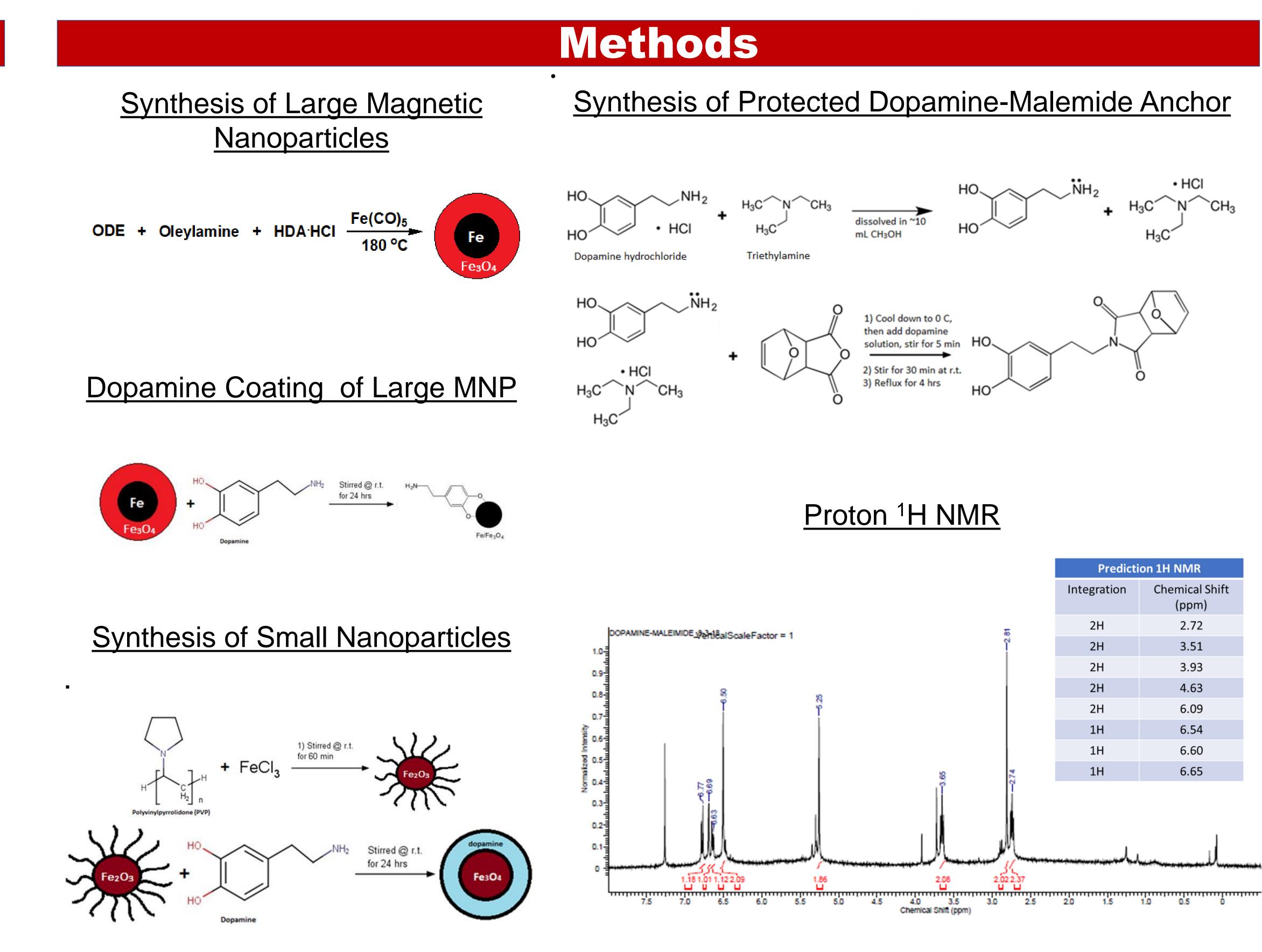
1.5	T ₁ Measurement		T ₂ Measurement		
1			1		
0.5			0.8		
0	T ₁ relaxa —Water 13.48 ±	tion time [s] 0.0044			T_2 relaxation time [s] 3.84 ± 0.0041
-0.5	Large Iron 6.69±0	.0019	0.6		0.72±0.0052
-1	NP	.0013	0.4	NP —— Small Iron	2.12±0.0042
	NP 2.54±0		0.2	NP	
-1.5	5 10 15 20 [seconds]	25 30			
			0 5	10 15 20) 25 30 35
			T ₁ (s)	T ₂ (s)	
	D20/H20(5%) 1		8 ± 0.0044	3.84 ± 0.0041	
	0.5 mg/mLFe/Fe ₃ O ₄ NPs (Large)		9 ± 0.0019	0.72 ± 0.0052	
	0.5 mg/mLFe ₂ O ₃ NPs (Small)		2 ± 0.0013	2.12 ± 0.0042	
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	good T_2 contrast	ET 21.00	w: 12.00 vxide NP	Large iron oxide NP	ET 4.50 W: 28.00 Small:Large (1:1)
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- Try new methods to optimize the attachment of large NP to cysteine (peptide).
- Finally, move on to do in-vitro and in-vivo testing.

Design of sensors for in-vivo detection of cancer related enzymes

Laura Soto, Jose Covarrubias, Stefan H. Bossmann Department of Chemistry, College of Arts and Sciences, Kansas State University, Manhattan, KS

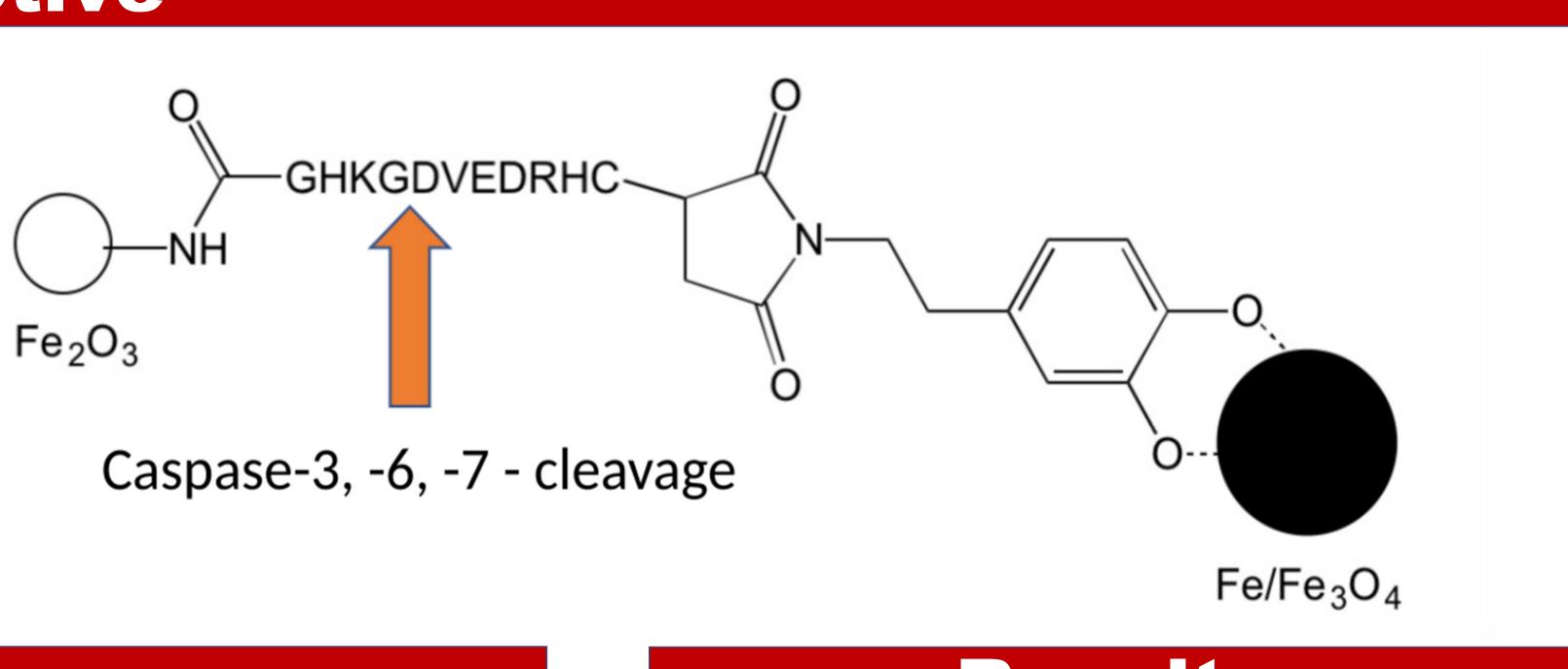
> The goal of this project is to create a nanobiosensor, which would have T_1 and T_2 based imaging capabilities to measure enzymatic activity. This tool will be able to differentiate between benign and malignant tumors invivo and to quantify the effect of cancer treatments, such as chemotherapy and radiation therapy.



Future Work

• Attach small NP to other end of peptide and assemble sensor together.

Objective



Developing Scholars Program Dr. Bossmann's Team at Kansas State Dr. Tej Shrestha & Dr. Simon Sham Johnson Cancer Research Center



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Results

- Dopamine-maleimide anchor was successfully synthesized.
- Results of the cysteine attachment were not very successful.
- Unfortunately, control had a higher sulfur content than sample.

Sulfur Analysis (ICP-OES)				
Sample ID	Sulfur Content (ppm)			
Standard 1	5.00			
Standard 2	8.00			
Standard 3	10.00			
Standard 4	30.00			
Standard 5	50.00			
Control (1mg/mL)	12.1808			
Sample Strategy (1mg/mL)	7.3509			

Acknowledgements