

## STUDENT HANDOUT

### Eu<sup>II</sup>-based Contrast Agents for Imaging Hypoxia in a Wide Range of Diseases

#### Description

This literature assignment focuses on a recent *JACS* paper (*J. Am. Chem. Soc.* 2022, 144, 23053 - 23060), which explores the chemistry of Eu<sup>II</sup>-based contrast agents. Chemists at Wayne State University (Detroit, MI) and researchers at Baylor College of Medicine (Houston, TX) have collaborated to investigate the first divalent lanthanide complex that persists in oxygenated environments for magnetic imaging resonance (MRI) applications.

**Learning Goals.** There are various goals for this activity, which reinforces fundamental inorganic chemistry concepts you learned in early courses and expands your expertise within the chemical literature.

**Assignment.** Your assignment is to read the published article and answer the following questions **before class**. Bring your responses to the questions in class for discussion with your peers. You will work in teams (2-4) and prepare a creative poster based on your responses for a gallery walk in class. The link to the article can be found below.

Systemic Delivery of Divalent Europium from Ligand Screening with Implications to Direct Imaging of Hypoxia

<https://pubs.acs.org/doi/full/10.1021/jacs.2c10373>

#### Evaluation

The class will develop a rubric for assessment of the posters for a competition.

#### Questions:

1. What is the significance of this research? Why are the authors doing this research?
2. What are the key results of this study?
3. Examine the chemical structures of ligands 5 and 9 in Figure 1. Using your knowledge of HSAB (Hard-Soft-Acid-Base) theory, predict if the ligands are hard or soft and explain **why** you conclude the ligands are hard or soft.
4. Determine the point group for ligands 5 and 9.
5. Examine the chemical structure of the Eu<sup>II</sup> complex in the graphical abstract. (a) What is the electron configuration for the metal center? (a) What is the coordination number around the metal center? (b) Describe the geometry around the metal center.
6. Try to write a complete overall reaction for the synthesis of Eu with ligands 5 and 9.
7. If you collected <sup>1</sup>H NMR spectra of ligands 5 and 9, how many unique protons would you expect for each ligand? What is the predicted multiplicity (e.g. singlet, doublet) for each proton? Which proton would you expect to be furthest downfield? Explain your answers. Draw the structure of the ligands using ChemDraw and clearly label the protons (e.g. H<sub>a</sub>, H<sub>b</sub>) to support your answers. (Use your knowledge of organic chemistry to help you!)

#### Gallery Walk and Poster Preparation

**Materials Needed:** Post-It poster paper, colorful markers, pencils, rulers

Work in teams and use your responses to prepare a creative poster. Your poster must briefly describe the significance of the research, include a chemical structure of a Eu<sup>II</sup> complex, and an overall reaction for the synthesis of the Eu complex with ligand 5 or 9.