Imaging pH levels with a Co^{II}_2 MRI Probe

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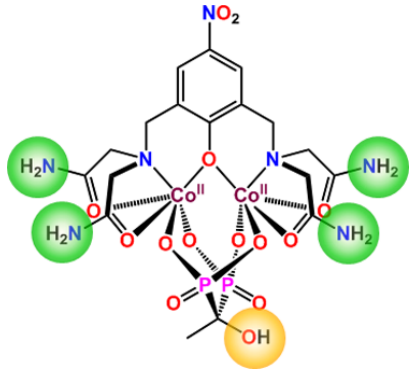
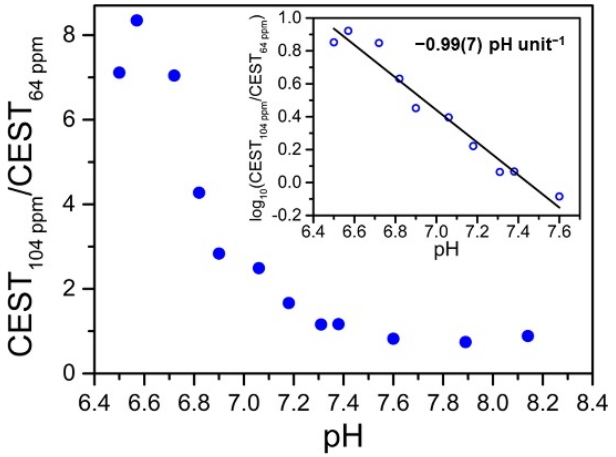
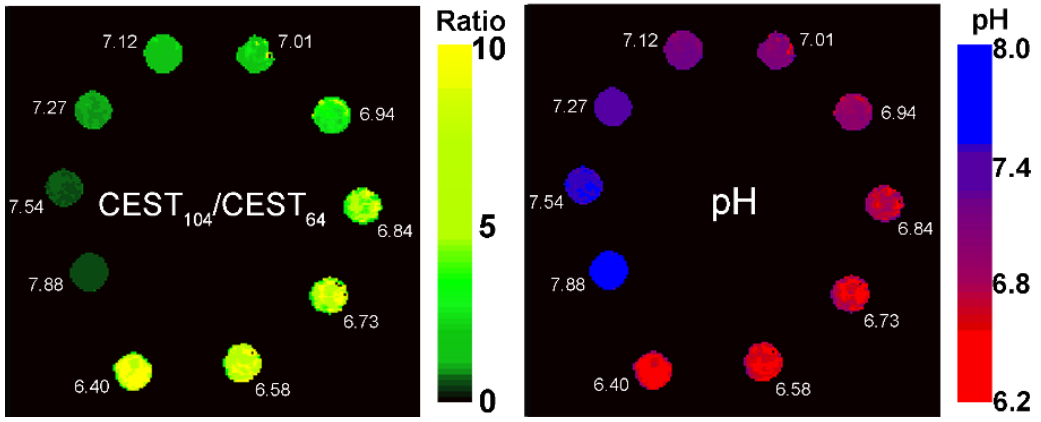
MagLab users developed cobalt complexes that function as pH-responsive PARAmagnetic Chemical Exchange Saturation Transfer (PARACEST) probes for pH mapping. A particularly interesting Co^{II}_2 complex features both carboxamide and hydroxyl groups **[top left]**. Due to its high sensitivity to pH over the physiological range, it provides the potential for using Magnetic Resonance Imaging to map pH via the CEST effect.

CEST-NMR analysis of this complex reveals highly pH-dependent ratios of CEST intensities at 104 and 64 ppm in the pH range 6.5–7.6 **[bottom left]**. These ratiometric values were used to construct a linear calibration curve of $\log_{10}(CEST_{104\ ppm}/CEST_{64\ ppm})$ vs pH **[top right]**. *Most importantly, analogous pH-dependent CEST intensities and linear pH behavior were observed through CEST-MR phantom images using the 17.6 T MRI at the NHMFL's AMRIS Facility* **[bottom right]**.







These results demonstrate that Co^{II}_2 complexes can provide a concentration-independent measurement of pH through ratiometric PARACEST imaging over a range of pH relevant for detecting physiological abnormalities. *Eventually, spatial mapping of tissue pH using MRI might aid in the early diagnosis and treatment of diseases, because acidic extracellular pH is a characteristic of various pathological conditions, including inflammation, cancer, and ischemia (inadequate blood supply to an organ).*

Facilities and instrumentation used: Bruker Avance III HD 750 MHz MRI system (89 mm vertical bore) at the MagLab's AMRIS Facility. Additional NMR measurements and characterization at the IMSERC with support from SHyNE at Northwestern University.

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