

## Characterization of "Spectroscopically Challenged" Metals: Zinc in Biological Systems

James E. Penner-Hahn, Rebecca Kelly, Matthew Kidd, and Suranjana Haldar

Department of Chemistry and the Biophysics Research Division  
University of Michigan, Ann Arbor, Michigan 48109-1055 USA

Zinc is the most common trace element and is the only transition metal known to be required for at least one enzyme in each of the major classes of enzymatic activities. Unfortunately, characterization of Zn(II) in biological systems is challenging. Zinc is found only in the Zn(II) oxidation state, and thus, as a  $d^{10}$  ion, is "silent" to most traditional spectroscopies. This makes the characterization of Zn sites extremely difficult in the absence of a crystal structure. X-ray spectroscopy, including extended x-ray absorption fine structure (EXAFS) and x-ray absorption near edge structure (XANES) is the principal exception to this generalization, and both EXAFS and XANES have found frequent application in the characterization of biological Zn sites. The applications of these to methods to the characterization of the structure and mechanism of the nucleophilic Zn sites in a novel class of Zn methyl-transfer enzymes will be described. In addition, recent work on *in vivo* characterization of Zn speciation will be described.