**Parahydrogen-Based Hyperpolarization (HP)**

**Dr. Roman Shchepin**

**Assistant Professor, Dept. of Chemistry, Biology, Health Sciences (CBH)**

**South Dakota School of Mines & Technology**

**Abstract:** This presentation will be largely focused on Parahydrogen-based hyperpolarization (HP).  Chemical induction of drought and salinity resistance in plants will be briefly mentioned as well.

I. Parahydrogen (pH2) based hyperpolarization is an exciting frontier of organic, analytical and physical chemistry. This revolutionary HP technique radically alters the “landscape” of Magnetic Resonance (MR) increasing MR signal by up to tens of million folds hence enabling molecular imaging on the proton and other (e.g. 13C, 15N and 19F) nuclei. The development of the technology encompasses both chemical and engineering projects. For instance, organic synthesis of tracers enriched with magnetically active stable isotopes is required in order to generate sufficient hyperpolarization payload (the product of the number of hyperpolarized nuclei and their NMR polarization). The production and observation of HP requires a system, which consists of pH2 generator, reaction chamber, purification filter and MR visualization component. Also, it is expected that the final system will be fully automated. For example, the development of inexpensive, high throughput pH2 is an immediate engineering project that addresses overarching goal of the research direction.

Background of parahydrogen-based polarization will be discussed briefly followed by new synthetic strategies enabling 15N, 13C enrichment of carboxylic acids & choline derivatives, imidazole & pyridine based scaffolds allowing efficient NMR hyperpolarization (approaching theoretical maximum of unity) at concentrations suitable for biomedical imaging applications. Previously developed instrumentation, which enabled various HP techniques, will be discussed as well.

          II. Drought and soil salinity accounts for billions of dollars lost revenue. For example, the severe drought of 2012 alone impacted 48 states resulting in more that $85 billion in lost crops. The technology based on ozonolysis aided production of betaine aldehyde will be proposed as a mean of combating drought and salinity stress in plants.

**Dr. Roman Shchepin** received a B.S. degree in Chemistry (Organic) in 2000 at Perm State University in Perm, Russia. He pursued his graduate studies at the University of Nebraska-Lincoln. He received his PhD in 2006 under the supervision of Prof. Pat Dussault, who is the world-class expert of ozonolysis, with the research projects at the interface of synthetic chemistry and chemical biology. Following his postdoctoral fellowship (2007-2010) at the Department of Chemistry at Vanderbilt University, he joined Vanderbilt University Institute of Imaging Science (VUIIS) as a research fellow (2010-2013) and was subsequently promoted to Research Assistant Professor at VUIIS. In August of 2019, Dr. Shchepin joined South Dakota School of Mines and Technology (SDSM&T) as an Assistant Professor. His research is focused on the area of Parahydrogen-based hyperpolarization (p-H2 HP), which is an exciting frontier of organic, analytical and physical chemistry. The development of HP instrumentation is an integral part of this effort as well. This revolutionary NMR hyperpolarization technique radically alters the “landscape” of Magnetic Resonance (MR) increasing MR signal by up to tens of million folds. Dr. Shchepin is also interested in ozonolysis based synthetic methodologies for combating drought and salinity stress in plants.

**When: Tuesday, February 4, 2020 at 4 pm**

**Where: EEP#252**