

Materials Joint Seminar

(Kitagawa-Furukawa-Horike-Fujita Group)

Photons, Radicals, Bubbles and Beer: Using Photochemistry and Electron Paramagnetic Resonance Spectroscopy to Understand the Universe



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Thursday May 31st, 2018 10:30-12:00
Kyoto University KUIAS (iCeMS Main Building)
2F Seminar Room (#A207)

Abstract:

Our laboratory has a long-standing interest in the structure, reactivity, and dynamics of free radicals in both homogeneous and heterogeneous media. In this lecture, the basic tenets of steady-state and time-resolved (CW) electron paramagnetic resonance spectroscopy (SSEPR and TREPR) are explained, and their use in understanding the physical and chemical behavior of free radicals is outlined. Examples to be presented include the use of stable nitroxide spin probes to investigate the drying and curing of architectural coatings, and to probe the physical properties structured (non-Newtonian) fluids at the molecular level. Chemical reactivity involving free radicals can be studied directly using TREPR, for example in the study of the mechanism for the lightstruck flavor (so-called “skunking”) of beer. Reactivity can also be investigated using spin trapping techniques. Two different trapping methods will be presented: nitrones can be used to confirm the mechanism of action of biocompatible polymer initiators, and the reaction of hindered amines with singlet oxygen can be used to quantify the kinetics and topology of such reactions in confined media. Finally, two applications of EPR spectroscopy to study molecular dynamics are presented: modulation of the exchange interaction in two Cu-Cu porphyrin dimers, and long-range radical-triplet state pair interactions in acrylic polymers in liquid solution. The role of molecular motion (rotational and translational) in confined spin-correlated radical pairs will also be explained.

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