Genetically encoded probes to study redox signaling

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Aerobic metabolism is tightly associated with the generation of reactive oxygen species (ROS). High levels of these molecules can lead to oxidative stress. However, in evolution, living systems have also learned to use some of these molecules to control numerous metabolic reactions and signaling pathways. As most reactive oxygen intermediates have a very transient nature and broad reactivity, studying them, particularly in the context of living cells and tissues, is challenging. In my talk, I will present two types of molecular tools that enable the characterization of spatiotemporal dynamics of ROS. The first type of tool, genetically encoded fluorescent sensors, allows real-time assessment of redox-active molecules in cells and tissues, from the nanometer to millimeter scale. The second type of tool, chemogenetic redox modulators, enables the changing of intracellular/subcellular levels of redox metabolites to identify the roles of these molecules in metabolism, signaling, stress, and cell fate decisions.