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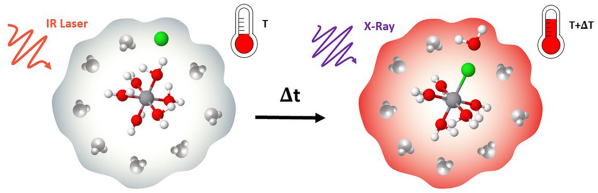
X-ray spectroscopy applications are extended to include the time-resolved study of reactions caused by temperature jumps in aqueous solutions.



Credit: OC LSU-EPFL

Light-driven reactions are only a subset of chemical and biochemical processes. An extension of time-resolved spectroscopic methods to thermally driven reactions would include a much larger variety of such processes. In a new paper, Cannelli et al. demonstrate the first use of a time-resolved X-ray spectroscopy probe in a temperature jump experiment to observe structural changes over the course of a chemical reaction. In a T-jump/X-ray probe experiment, a sudden temperature triggers a chemical reaction, whose intermediates are probed during the ongoing process.

“One should bear in mind that most of the natural and man-made chemistry and biochemistry is thermally driven,” said author Majed Chergui.

Water is the most important solvent in nature and is ideal because it can be rapidly heated. While T-jump experiments have for decades been used with a large variety of optical spectroscopic probes, the key novelty in this work is the use of X-ray pulses to monitor thermally driven reactions with element- and structural-sensitivity.

To demonstrate this, the researchers investigated a model reaction in which cobalt ions in an aqueous solution containing chloride ions change their coordination from water molecules to chloride ions upon a temperature increase.

This work is a step towards the time-resolved investigation of thermally driven chemical and biochemical reactions using X-ray methods, though further studies are necessary.

“Probing the structural evolution of reactions by X-rays is possible for light-driven reactions, because photochemical triggers are impulsive,” Chergui said. “The T-jump method in aqueous media is another trigger that can now be used. It expands the application of time-resolved X-ray methods to a much larger range of chemical and biochemical reactions.”

Source: “Towards time-resolved laser T-jump/X-ray probe spectroscopy in aqueous solutions,” by O. Cannelli, C. Bacellar, R. A. Ingle, R. Bohinc, D. Kinschel, B. Bauer, D. S. Ferreira, D. Grolimund, G. Fulvia Mancini, and M. Chergui, *Structural Dynamics* (2019). The article can be accessed at https://doi.org/10.1063/1.5129626.