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Radiation-Induced Interhalogen Chemistry in Molten Salts

June 2023

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Idaho National Laboratory

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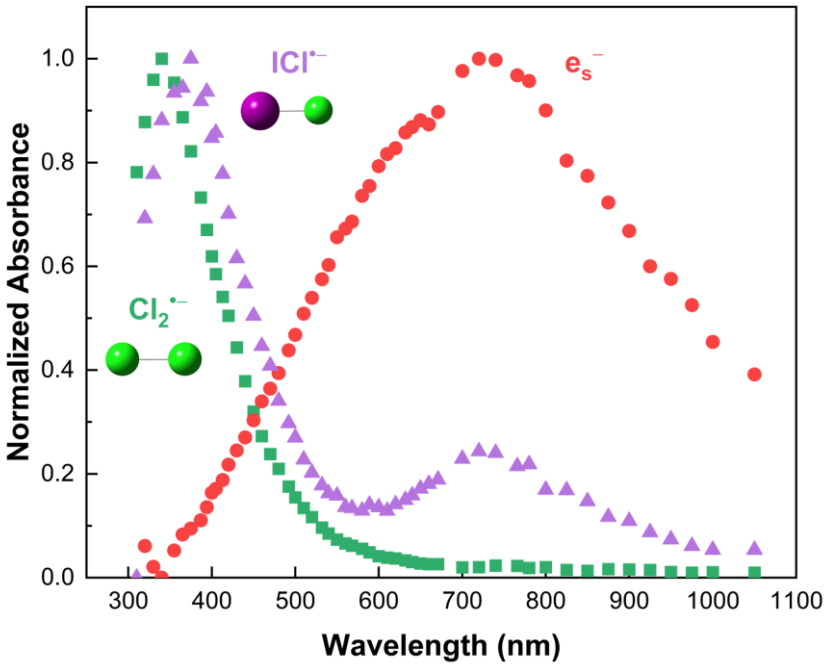

Normalized, deconvoluted transient spectra from the electron pulse irradiation of molten KI (10 wt.%) in LiCl-KCl eutectic at 400°C (**ICl•−** = iodine-chlorine radical anion, **Cl$_2$•−** = dichlorine radical anion, and **e$_S$$^-$** = solvated electron).

J.K. Conrad, K. Iwamatsu, M.E. Woods, R. Gakhar, B. Layne, A.R. Cook, and G.P. Horne, *PCCP* **2023**, DOI: 10.1039/d3cp01477k.

This work was performed at Idaho and Brookhaven National Laboratories (INL and BNL) and used resources of the BNL Accelerator Center for Energy Research.

Scientific Achievement

The transient interhalogen species (**ICl•−**) has been identified and observed for the first time in irradiated iodide-containing molten chloride salt mixtures, exhibiting a lifetime on the order of microseconds.

Significance and Impact

The radiation chemistry of interhalogen species in molten salt reactors is unknown. The formation of **ICl•−** has significant implications for the transport and accumulation of fission-product iodine in these extreme environments.

Research Details

- Transient spectra and chemical kinetics were measured to determine the impact of iodide ions on the fundamental radiation chemistry of molten chloride salt mixtures as a function of temperature (400–700°C).
- Spectro-kinetic analysis (*SK-Ana*) software, and gas-phase density functional theory calculations were employed for spectral deconvolution and transient identification, respectively.