

IMAGING THE REACTIVE RADICAL-CATION COMPLEX IN THE IONIZED LIQUID WATER

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Liquid water is important in nature and plays a critical role in numerous chemical and biological applications. The elementary reaction pathways for ionized water have been extensively studied, however, the short-lived reactive complex and its structural dynamic response after the proton transfer reaction remain illusive. Using a liquid-phase ultrafast electron diffraction technique to study the intermolecular oxygen-oxygen and oxygen-hydrogen bonds, we captured the short-lived radical-cation complex $\text{OH}(\text{H}_3\text{O}^+)$ that was formed within 140 fs through a direct and fast oxygen-oxygen bond contraction and proton transfer, followed by the radical-cation pair dissociation and the subsequent structural relaxation of water shells within 250 fs. These studies provide direct evidence of this short-lived metastable radical-cation complex before separation, therefore improving our fundamental understanding of elementary reaction dynamics in ionized liquid water.