Initial metal-metal bond breakage detected by fs X-ray scattering in the photolysis of Ru$_3$(CO)$_{12}$ in cyclohexane at 400 nm

Using femtosecond resolution X-ray solution scattering at a free electron laser we were able to directly observe metal-metal bond cleavage upon photolysis at 400 nm of Ru$_3$(CO)$_{12}$, a prototype for the photochemistry of transition metal carbonyls. This leads to the known single intermediate Ru$_3$(CO)$_{11}$(μ-CO)$^*$, with a bridging ligand (μCO) and where the asterisk indicates an open Ru$_3$-ring. This loses a CO ligand on a picosecond time scale yielding a newly observed triple bridge intermediate, Ru$_3$(CO)$_9$(μ-CO)$_3$$^*$. This loses another CO ligand to form the previously observed Ru$_3$(CO)$_{10}$, which returns to Ru$_3$(CO)$_{12}$ via the known single-bridge Ru$_3$(CO)$_{10}$(μ-CO). These results indicate that contrary to long standing hypotheses, metal-metal bond breakage is the only chemical reaction immediately following the photolysis of Ru$_3$(CO)$_{12}$ at 400 nm. Combined with previous picosecond resolution X-ray scattering data and time resolved infrared spectroscopy these results yield a new mechanism for the photolysis of Ru$_3$(CO)$_{12}$.

General information
Publication status: Published
Organisations: Neutrons and X-rays for Materials Physics, Department of Physics, Synchrotron Soleil, Technical University of Denmark, European XFEL, SLAC National Accelerator Laboratory, European Synchrotron Radiation Facility, Pierre and Marie Curie University - University of Paris VI, Sorbonne Universités, Center for High Pressure Science and Technology Advanced Research, EMBL Heidelberg
Number of pages: 9
Pages: 319-327
Publication date: 2019
Peer-reviewed: Yes

Publication information
Journal: Photochemical & Photobiological Sciences
Volume: 18
Issue number: 2
ISSN (Print): 1474-905X
Ratings:
BFI (2019): BFI-level 1
Web of Science (2019): Indexed yes
Original language: English
DOIs:
10.1039/c8pp00420j
Source: FindIt
Source-ID: 2442590699
Research output: Contribution to journal › Journal article – Annual report year: 2019 › Research › peer-review