



HAL
open science

Ion induced fragmentation of diatomic molecular clusters

A Méry, A Agnihotri, J Douady, X Fléchar, B Gervais, S Guillous, W Iskandar, E Jacquet, V Kumar, J Matsumoto, et al.

► **To cite this version:**

A Méry, A Agnihotri, J Douady, X Fléchar, B Gervais, et al.. Ion induced fragmentation of diatomic molecular clusters. 31st International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC31), Jul 2019, Deauville, France. pp.152068, 10.1088/1742-6596/1412/15/152068 . hal-03345634

HAL Id: hal-03345634

<https://hal.science/hal-03345634>

Submitted on 1 Jun 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

PAPER • OPEN ACCESS

Ion induced fragmentation of diatomic molecular clusters

To cite this article: A Méry *et al* 2020 *J. Phys.: Conf. Ser.* **1412** 152068

View the [article online](#) for updates and enhancements.

You may also like

- [Complementary imaging of the nuclear dynamics in laser-excited diatomic molecular ions in the time and frequency domains](#)
M Magrakvelidze, A Kramer, K Bartschat et al.
- [New results for laser isotope separation using low-energy methods](#)
G N Makarov
- [Laser IR fragmentation of molecular clusters: the role of channels for energy input and relaxation, the influence of surroundings, and the dynamics of fragmentation](#)
G N Makarov



ECS Membership = Connection

ECS membership connects you to the electrochemical community:

- Facilitate your research and discovery through ECS meetings which convene scientists from around the world;
- Access professional support through your lifetime career;
- Open up mentorship opportunities across the stages of your career;
- Build relationships that nurture partnership, teamwork—and success!

Join ECS!

Visit electrochem.org/join



Ion induced fragmentation of diatomic molecular clusters

A Méry^{1*}, A N Agnihotri¹, J Douady¹, X Flécharde², B Gervais¹, S Guillous¹, W Iskandar³, E Jacquet¹, V Kumar¹, J Matsumoto⁴, J Rangama¹, F Ropars¹, C P Safvan⁵, H Shiromaru⁴, D Zanuttini¹ and A Cassimi¹

¹ CIMAP, CEA-CNRS-ENSICAEN-UNICAEN, Normandie Université, BP5133, F-14050 Caen Cedex 04, France

² Normandie Univ, ENSICAEN, UNICAEN, CNRS/IN2P3, LPC Caen, 14000 Caen, France

³ Chemical Science Division, Lawrence Berkeley National Laboratory, Berkeley, CA-94720, USA

⁴ Department of Chemistry, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji, Tokyo, Japan 192-0397

⁵ Inter University Accelerator Center, Aruna Asaf Ali Marg, New Delhi 110067, India

Synopsis Weakly bound atomic or molecular clusters are of growing interest in the fields of atmospheric science, hadron-therapy or astrophysics. We will present our recent experimental results on the fragmentation of diatomic molecular dimers after irradiation by highly charged ions. For $(N_2)_2$ dimers, the measured KER spectrum is very similar to the one of the N_2 monomers but is globally shifted towards higher energies. Moreover, sequential dissociation of the $(CO)_2$ dimers has been observed when metastable states of the CO^{2+} dications are populated.

Diatomic molecular dimers such as $(N_2)_2$ and $(CO)_2$ are model systems containing both covalent intramolecular bonds and van der Waals intermolecular bonds. Following multiple electron capture, both intramolecular and intermolecular fragmentation may occur. We will focus on some particular 3-body dissociation channels where only one of the constitutive molecule breaks while the other cation remains in a non-dissociative state. For such channels, the influence of a second spectator ion on the molecular dissociation has been investigated.

We use a COLTRIMS setup (COLd Target Recoil Ion Momentum Spectroscopy) to perform cross beam collisions between molecular dimers produced by a supersonic gas jet and highly charged ions delivered by the low energy beam line of the GANIL/ARIBE facility. The charged fragments produced in the collision are measured in coincidence and their three-dimension momentum vectors are computed thanks to their position and time-of-flight on a position sensitive detector. A clean data selection is then achieved by imposing momentum conservation laws. The kinetic energy of each fragment as well as the KER (Kinetic Energy Release) are deduced from

the momentum vectors and m/q identification of the fragments. Finally, a comparison between events originating from monomer or dimer targets is performed from a single experiment.

In the case of $(N_2)_2$ dimers, the measured KER spectra are globally shifted towards higher energies in comparison to the fragmentation of the N_2 monomer. The value of the energy shift is fairly well reproduced by accounting for the additional Coulomb potential energy due to presence of the neighbor ion [1]. This indicates that the presence of the second molecule has a weak influence on both electron capture and molecular fragmentation dynamics. For $(CO)_2$ dimers, similar results are observed but concerted and sequential fragmentation of the dimer have also been identified. These two processes are respectively associated to the population of either short or long lived excited states of the CO dication. As a consequence, molecular fragmentation within such dimers can be used as a tool to distinguish between short lived and metastable states of the monomer cations.

References

[1] Méry A *et al* 2017 *Phys. Rev. Lett.* **118** 233402

*E-mail: alain.mery@ganil.fr

