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Photo-dissociation of dimer cations of PAHs stored in a compact electrostatic ion storage ring

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In our study of Polycyclic Aromatic Hydrocarbons (PAHs) dimer cations such as di-benzene, di-naphthalene and di-pyrene, we use a compact electrostatic ion storage ring, the Mini-Ring. Dimer cations of PAHs are produced by using an electron cyclotron resonance plasma ion source (ECR) with low HF power and high pressure. They are stored in the Mini-Ring up to 100 ms in order to characterize the dynamics of dissociation and of radiative relaxation. We performed a coincidence experiment between neutrals detected by the channeltron and ions detected by the PSD. We used the Mini-Ring for half a revolution setting C1 and D3 voltages to half of their nominal values and D4 to 0 V to drive the cationic monomer fragment to the PSD. The laser beam was deflected to cross the ion beam between D2 and C1 to enhance the number of dissociation events. To record their photo-dissociation spectrum they are stored for about 2ms reducing this the background counts resulting from dissociation of hot cations. The photo-dissociation spectra are recorded as a function of OPO laser wavelength in the range 300-1400 nm. Two bands appear in this region: the most intense in the near infrared region is attributed to the charge resonance transition (CR) and the other one in the visible range is attributed to the local excitation transition (LE). The CR band is much broader compared to previous experiments by Inokuchi et al1. due to the higher temperature of the stored dimer cations in our experiment. Indeed, the studies of the cooling dynamics show that radiative cooling can only be due to infrared emissions on a much longer time scale compared to our 2 ms storage time. We plan to perform experiments at DESIREE with very long storage times like up to 10 s to study the evolution of the broadening and the center positions of the CR and LE bands as a function of the temperature.

Reference:
1. Inokuchi, Y., Ohashi, K., Matsumoto, M. & Nishi, N. Photodissociation Spectrum of Naphthalene Dimer Cation. J. Phys. Chem. 99, 3416–3418 (1995).

Authors: Mr AL MOGEETH, Abdulaziz (Institut Lumière Matière, UMR5306 Université Lyon 1-CNRS, Université de Lyon); Dr BERNARD, Jerome (Institut Lumière Matière, UMR5306 Université Lyon 1-CNRS, Université de Lyon); Prof. CHEN, Li (Institut Lumière Matière, UMR5306 Université Lyon 1-CNRS, Université de Lyon); Prof. MARTIN, Serge (Institut Lumière Matière, UMR5306 Université Lyon 1-CNRS, Université de Lyon)

Presenter: Mr AL MOGEETH, Abdulaziz (Institut Lumière Matière, UMR5306 Université Lyon 1-CNRS, Université de Lyon)

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