Probing the electron-phonon coupling in clusters through resonant vibrational excitation

Valeriy Chernyy[1,2], Remko Logeman[2], Andrei Kirilyuk[2], and Joost M. Bakker[1]

[1]*Radboud University, Institute for Molecules and Materials, FELIX Laboratory, Toernooiveld 7c, 6525 ED Nijmegen, the Netherlands*

[2]*Radboud University, Institute for Molecules and Materials, Heyendaalseweg 135, 6525 AJ Nijmegen, the Netherlands*

j.bakker@science.ru.nl

Atomic clusters uniquely bridge the gap between the discrete electronic levels of atoms and the correlated band structure of bulk matter. As a well-defined and fully controllable system free from outer influences, gas phase clusters provide an excellent opportunity to explore such fundamental properties of matter as the electron-phonon coupling, responsible for important physical phenomena like superconductivity, polarons and the acoustoelectric effect. We study the e-ph interaction by exciting the nuclear coordinates of a cluster with an IR laser and register the response in the electronic system above the Fermi level, with UV photoionization. We here present the electronic response from metal and metal carbide clusters on pure vibrational excitation and discuss the feasibility for ps-domain time-resolved experiments, revealing a real-time view of the energy flow from a selectively excited vibration to the electrons.

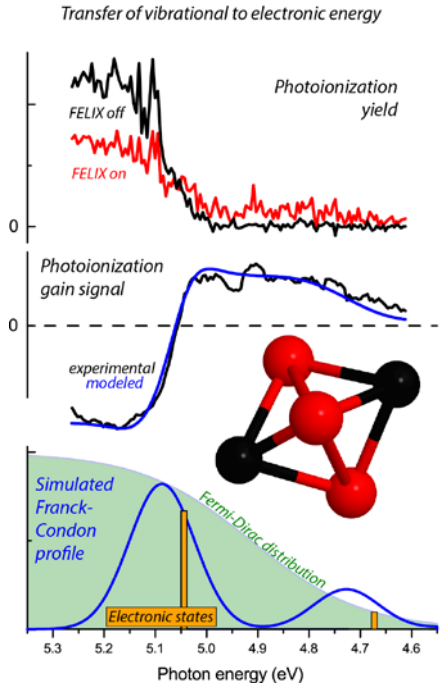

Figure 1: Photoionization spectra for Nb_3C_2 with and without IR vibrational excitation (top panel); the resulting experimental and modeled gain function (middle panel) based on the thermally populated electronic states.

[1] J. Jalink, J.M. Bakker, Th. Rasing,A. Kirilyuk, ”Channeling Vibrational Energy To Probe the Electronic Density of States in Metal Clusters”, J. Phys. Chem. Lett. 6, 750–754 (2015)