PULSED DISCHARGE NOZZLE CAVITY RING DOWN SPECTROSCOPY OF COLD PAH IONS

L. BIENNIER, F. SALAMA, L.J. ALLAMANDOLA, *NASA–Ames Research Center, Space Science Division, MS 245-6, Moffett Field, CA 94035-1000, USA*; J.J. SCHERER, A. O'KEEFE, *Los Gatos Research, 67 East Evelyn Ave., Suite 3, Mountain View, CA 94041, USA*.

We report progress in our systematic investigation of the contribution of the class of polycyclic aromatic hydrocarbon (PAH) ions to the interstellar extinction curve and to the diffuse interstellar bands (DIBs). We present and discuss the gas-phase electronic absorption spectra of selected ionized PAHs measured in the UV-Visible-NIR range in an astrophysically relevant environment. The study has been carried out using the ultrasensitive and versatile technique of cavity ringdown spectroscopy (CRDS) coupled to a cold plasma source following the approach developed during the feasibility studies that led to the first detection of the naphthalene ion in the gas phase [a]. The harsh physical conditions of the interstellar medium - characterized by a low temperature, an absence of collisions and strong VUV radiation fields - have been simulated in the laboratory by associating a pulsed-CRDS spectrometer with a supersonic slit jet seeded with PAHs and an ionizing, penning-type, electronic discharge [b]. We have first applied this new instrument to the measurement of the electronic spectrum of the cold naphtalene ion ($C_{10}H_8^+$) in order to compare with the results obtained during the feasibility phase[a]. The study has then been successfully extended to other mid-size PAHs that have been preselected from Matrix Isolation Spectroscopy (MIS) such as acenaphthene ($C_{12}H_{10}^+$) and pyrene ($C_{16}H_{10}^+$) ions among others [c].

These experiments provide unique information on the spectra of free, large carbon-containing molecules and ions in the gas phase. A parallel effort has been attempted to quantify the mechanism of ion production in the free jet expansion and to model our simulation of the diffuse interstellar medium in the laboratory. We also discuss the comparison of laboratory data with recent high resolution spectra of broad DIBs.

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[b] L. Biennier, F. Salama, A. Kachanov, L. J. Allamandola, J. Scherer and A. O'Keefe, Ohio State University, 56th International Symposium on Molecular Spectroscopy, WH01 (2001)

[c] F. Salama, in Solid Interstellar Matter: The ISO Revolution L. d'Hendecourt et al. eds, EDP Sciences, Springer-Verlag, p. 65 (1999)