Highlights of Astronomy, Volume 16
XXVIIIth IAU General Assembly, August 2012
T. Montmerle, ed.

doi:10.1017/S1743921314012976

Near-Infrared Spectroscopy of the Diffuse Galactic Emission

T. Onaka[1], I. Sakon[1], R. Ohsawa[1], T. I. Mori[1], H. Kaneda[2], M. Tanaka[3], Y. Okada[4], F. Boulanger[5], C. Joblin[6] and P. Pilleri[7]

[1]Department of Astronomy, The University of Tokyo, Tokyo 113-0033, Japan
email: onaka@astron.s.u-tokyo.ac.jp

[2]Graduate School of Science, Nagoya University, Aichi 464-8602, Japan

[3]Center for Computational Sciences, University of Tsukuba, Ibaraki 305-8577, Japan

[4]I. Physikalisches Institut, Universität zu Köln, 50937 Köln, Germany

[5]Institut d'Astrophysique Spatiale (IAS), UMR 8617, CNRS
& Université Paris-Sud 11, Bâtiment 121, 91405 Orsay Cedex, France

[6]Université de Toulouse, UPS-OMP, IRAP & CNRS, IRAP, 31028 Toulouse Cedex 4, France

[7]Centre de Astrobiología (INTA-CSIC), 28850 Torrejón de Ardoz, Spain
& Observatorio Astronómico Nacional, Apdo. 112, 28803 Alcalá de Henares, Spain

Abstract. The near-infrared (NIR) spectral range (2–5 μm) contains a number of interesting features for the study of the interstellar medium. In particular, the aromatic and aliphatic components in carbonaceous dust can be investigated most efficiently with the NIR spectroscopy. We analyze NIR spectra of the diffuse Galactic emission taken with the Infrared Camera onboard *AKARI* and find that the aliphatic to aromatic emission band ratio decreases toward the ionized gas, which suggests processing of the band carriers in the ionized region.

Keywords. ISM: general, (ISM:) dust, extinction, infrared: ISM, infrared: general

---

The near-infrared (NIR) spectral range from 2 to 5 μm contains a number of important features of gaseous and solid species in the interstellar medium (ISM). Absorption features of several major ices are observed at 3 μm (H_2O), 4.3 μm (CO_2), and 4.6 μm (CO) (e.g., Shimonishi *et al.* 2010). In this spectral range, there are also the fundamental vibration mode of CO gas (e.g., Rho *et al.* 2012) and several molecular hydrogen lines, from which we can estimate the physical conditions of the warm gas (e.g., Lee *et al.* 2011). In addition, it contains emission features of hydrocarbon dust around 3 μm, which allow us to investigate aromatic and aliphatic components (Boulanger *et al.* 2011; Kwok & Zhang 2011; Jones 2012). The 3.3 μm emission band, which is commonly attributed to polycyclic aromatic hydrocarbons (PAHs), is useful to study the size distribution and the processing of the band carriers in the ISM (e.g., Mori *et al.* 2012). Deuterated hydrocarbon features are also expected to be present in 4.4–4.7 μm (e.g., Peeters *et al.* 2004, Onaka *et al.* 2011). Despite these interests, however, this spectral range has barely been explored by instruments with high sensitivity.

The Infrared Camera (IRC: Onaka *et al.* 2007) onboard *AKARI* (Murakami *et al.* 2007) enabled for the first time high-sensitivity spectroscopy in the NIR, with a spectral-resolution of $\lambda/\Delta\lambda \sim 100$ (Ohyama *et al.* 2007). Even after the exhaustion of the cryogen, the IRC continued to carry out NIR observations and obtained a large number of NIR spectra in various celestial objects (Onaka *et al.* 2010).

As part of the Interstellar Medium in our Galaxy and Nearby Galaxies program (ISMGN: Kaneda *et al.* 2009), we carried out NIR spectroscopy towards more than 100 positions in the Galactic plane. We describe here the 3 μm data. We fit the observed

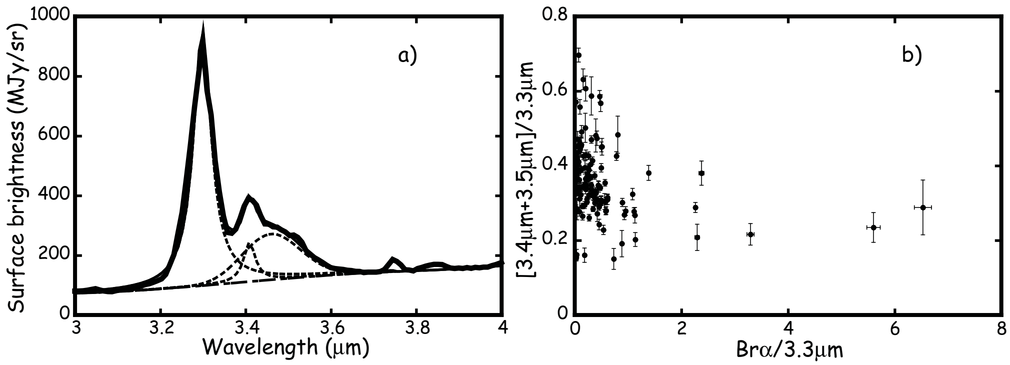

Figure 1. a) Example of *AKARI*/IRC NIR spectrum. The dotted lines indicate the decomposition of the 3.3, 3.4, and 3.5 μm bands (see text). The thick and thin solid lines represent the observed and fitted spectra, respectively. The dot-dashed line shows the continuum. b) The aliphatic to aromatic band ratio against the Brα to the 3.3 μm band intensity ratio (see text).

features with two Lorentzians (3.3 and 3.4 μm) and one Gaussian (3.5 μm). This fit is merely technical due to the low spectral-resolution of the instrument, but correctly estimates the aromatic (the 3.3 μm band) and the aliphatic (the summation of the 3.4 and 3.5 μm bands) band intensities. Figure 1a shows an example of the IRC spectrum together with the fit. Figure 1b plots the ratio of the aliphatic to aromatic band intensities against the ionized gas indicator, the ratio of Brα to the 3.3 μm band intensities. A trend is seen that the aliphatic to aromatic ratio decreases towards the ionized region. This implies a preferential destruction of aliphatic bonds relative to aromatic bonds in the ionized gas as described in Joblin *et al.* (1996) or that the aliphatic component resides mostly in small band carriers, which are quickly destroyed in the ionized gas (Mori *et al.* 2012).

Acknowledgements

This work is based on observations with *AKARI*, a JAXA project with the participation of ESA. The author thanks all the members of the *AKARI*/ISMGN team for their continuous help and encouragements. This work is supported in part by a Grant-in-Aid for Scientific Research from the Japan Society for the Promotion of Science.

References

Boulanger, F., Onaka, T., Pilleri, P., & Joblin, C. 2011, *EAS Publ. Ser.* 46, 399
Joblin, C., Tielens, A. G. G.. M., Allamandola, L. J., & Geballe, T. R. 1996, *ApJ* 458, 610
Jones, A. P. 2012, *A&A* 540, A2
Kaneda, H., Koo, B.-C., Onaka, T., & Takahashi, H. 2009, *Adv. Sp. Res.* 44, 1038
Kwok, S. & Zhang, Y. 2011, *Nature* 479, 80
Lee, H.-G., Moon, D.-S., Koo, B.-C., *et al.* 2011, *ApJ* 740, 31
Mori, T. I., Sakon, I., Onaka, T., Kaneda, H., Umehata, H., & Ohsawa, R., 2012, *ApJ* 744, 68
Murakami, H., Baba, H., Barthel, P., *et al.* 2007, *PASJ* 59, S369
Ohyama, Y., Onaka, T., Matsuhara, H., *et al.* 2007, *PASJ* 59, S411
Onaka, T., Matsuhara, H., Wada, T., *et al.* 2007, *PASJ* 59, S401
Onaka, T., Matsuhara, H., Wada, T., *et al.* 2010, *Proc. of SPIE* 7731, 77310M
Onaka, T., Sakon, I., Ohsawa, R., *et al.* 2011, *EAS Publ. Ser.* 46, 55
Peeters, E., Allamandola, L. J., Bauschlicher, C. W., Jr., *et al.* 2004, *ApJ* 604, 252
Rho, J., Onaka, T., Cami, J., & Reach, W. T. 2012, *ApJ* 747, L6
Shimonishi, T., Onaka, T., Kato, D., *et al.* 2010, *A&A* 514, A12