C_{60} as a probe for astrophysical environments

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After having been searched for three decades in the ISM, fullerene detection in a planetary nebula was reported in 2010 (Cami et al. 2010) and, later on, fullerenes have been found in a variety of space environments (Roberts et al. 2012). From the very first report and in successive publications, the C_{60} molecule has been used by astronomers to probe the conditions of astrophysical environments.

The use of fullerenes as a probe for astrophysical environments is possible because the observed emission in the mid-infrared ultimately depends on the intrinsic strength of the vibrational bands and the excitation mechanism of the fullerenes. The accuracy of the estimations therefore relies on the laboratory spectroscopic data of the fullerenes. In particular, when the excitation has a thermal origin, the intrinsic strength of the bands obtained in the laboratory is used to estimate the temperature of the molecules in the ISM (Cami et al. 2010; Bernard-Salas et al. 2012; Garcia-Hernandez 2012). Unfortunately, the data on the relative strengths of the main IR-bands of C_{60} published so far is limited, and shows a considerable amount of disagreement (Bernard-Salas et al. 2012). In fact, we have observed in the laboratory a high variability of the mid-IR features in solid C_{60} films, which can be due to a size effect of the solid particles and other reasons such as the interaction between the fullerene and the substrate or the presence of amorphous carbon produced during the thermal deposition of the fullerene films.

We have developed a technique to produce fullerene films, which delivers highly reproducible spectroscopic data suitable for astrophysical application. We have considered in our studies the effects of temperature and interaction with the substrate and other carbonaceous particles. We discuss the impact of the application of our data to probe the excitation mechanism in astrophysical environments.

References:

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