

CONTRIBUTION OF PAHS TO THE INTERSTELLAR EXTINCTION CURVE

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ABSTRACT. Absorption spectra of some gaseous PAHs, either pure species or natural mixtures, have been obtained in the VUV-visible region and compared to the interstellar extinction curve. The assumption that free PAHs are ubiquitous in the ISM cannot be rejected by incompatibility between the interstellar extinction curve and the absorption spectra of such molecules. PAHs absorb in the FUV rise and may give an important contribution to the bump at 2200 Å. We have derived that about 15% of the cosmic carbon is involved in these molecules.

1. Introduction

The astrophysical presence of PAHs has been suggested by the similarity between the unidentified IR bands, seen in emission at 3.3 - 6.2 - 7.7 and 11.3 μm in several astrophysical environments, and vibrational features of such molecules. If the whole energy emitted in the 12 μm IRAS band is due to PAHs then these molecules contribute to almost 20% of the absorption by dust. The PAH model has therefore to be tested by comparing absorption spectra of these molecules to the extinction curve. However, published spectra have been obtained in solutions and, restricted to wavelengths larger than 2500 Å, do not permit to conclude.

2. Results

We have measured the absolute absorption cross-sections of various gaseous PAHs on a large spectral range 400 Å - 7000 Å with a resolution of 20 Å, using the Orsay synchrotron radiation facility (LURE). Studied molecules are pure species and natural mixtures. These mixtures are certainly different from the interstellar ones, but they can help to understand the behaviour of the absorption spectrum when a great deal of species is involved.

Figure 1 shows the absorption spectra of coronene and of two mixtures obtained by evaporation of some natural mixtures: coal pitch and catalytic deposit extracts. The composition of the gaseous mixtures, computed with an evaporation model, is given in fig.1d and 1e.

Each laboratory spectrum is compared to the interstellar absorption curve attributed to small grains. This curve has been derived from the total extinction one, by subtracting the contribution of big grains calculated in Désert et al. (1990) and by assuming a zero albedo for small grains. The main result is that laboratory spectra and the interstellar curve are rather similar in first approximation. All spectra show a rise in the FUV. In the near UV, individual molecules exhibit prominent features but these features merge into some wider structures when a sufficient number of species are present. However, some accumulation points may appear like the point at 2100 Å in some of our mixtures. An absorption tail stretches further in the visible as molecules become larger.

3. Discussion

Studied molecules are different from interstellar ones that are expected to be larger, partly ionised and possibly dehydrogenated. However, from the analysis of our spectra, we conclude that there is no incompatibility between the extinction curve and the presence of PAHs in the ISM. Moreover, we propose that no individual PAH is dominant in the ISM and that interstellar mixtures have a wide mass distribution necessary to obtain a smooth structure. An accumulation point may exist at the 2200 Å bump position. In summary, interstellar PAHs absorb the energy they reemit in the IR, in the FUV rise, in a UV-visible continuum and possibly in the bump. From the energetic budget, we can derive that 15% of the cosmic carbon is implied in PAHs, if these molecules have to account for the whole 12 μm IRAS band emission.

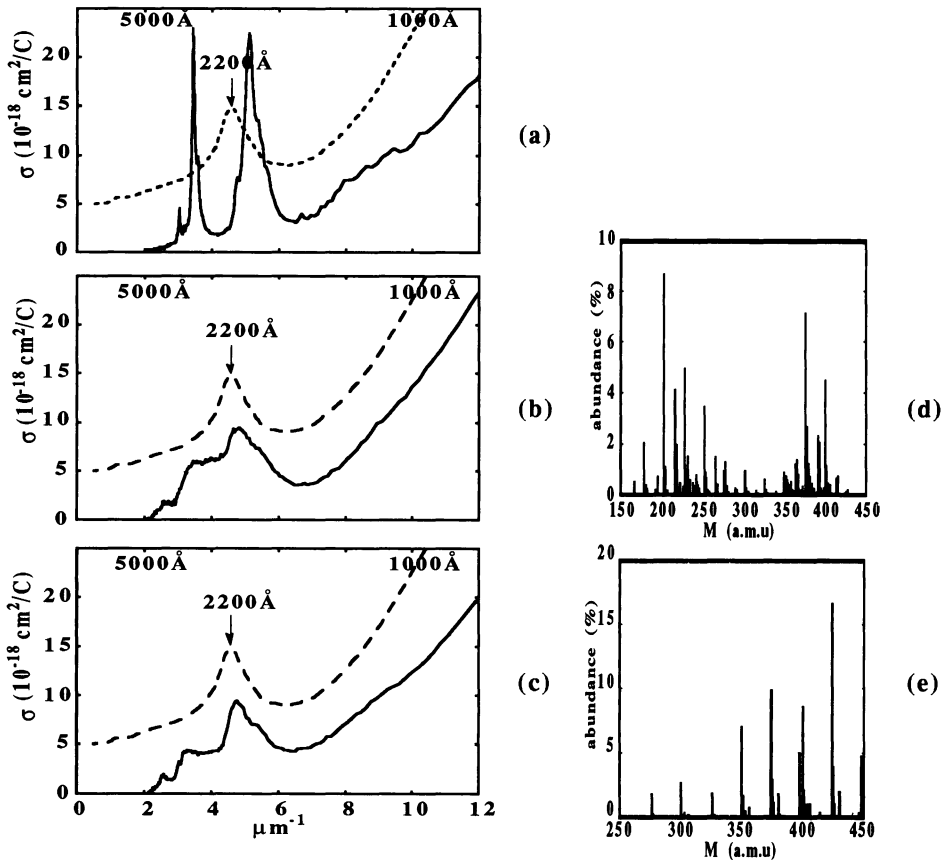


Figure 1. Comparison of the interstellar absorption curve of small grains (dashed line; offset, arbitrary units) with absorption spectra of PAHs (full line): (a) coronene, (b) gaseous mixture from coal pitch extract and (c) from catalytic deposit extract. (d) and (e) are mass spectra associated respectively with mixtures (b) and (c).

REFERENCES

Désert F.-X., Boulanger F., Puget J.L. (1990), *A. & A.* **237**, 215-236