Investigation of carbonaceous interstellar dust analogues by infrared spectroscopy: Effects of energetic processing

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Interstellar hydrocarbon dust

IR absorption features

3.4 μm band

J. Chiar et al. *ApJ* 2013, 770, 78
A. P. Jones *ASP Conf. Ser.* 414, 2009

Carbonaceous dust in the diffuse ISM

Aliphatic features are more prominent

their absorption strengths are much higher

Structure estimates by Dartois et al. suggest an **important contribution of hydrogen rich aliphatic carbon**

E. Dartois et al. *A&A*, 2007, 463, 635

Amorphous C/H ternary diagram

E. Dartois et al. *A&A*, 2007, 463, 635

Carbonaceous dust in the diffuse ISM

UKIRT spectra toward the Galactic center Quintuplet Cluster

Left: weighted average of the spectra of the six quintuplet lines of sight. *Right:* ISO spectra

Structure estimates by Chiar et al. suggest that the dust is **hydrogen poor** and **highly aromatic**

J. Chiar et al. *ApJ*, 2013, 770, 78

HAC film deposition in CH₄/He plasma

IEM-CSIC

Inductively coupled RF discharge reactor

- CH₄(40%)/He
0.3 mbar
- 40 W , 13.56 MHz

outside the coil
HAC1

inside the coil
HAC2

Film thickness ~ 3 μm
1 hour

IR spectra of the deposits

Analysis of HAC spectra

H	0.33
sp^2	0.55
sp^3	0.11

H	0.13
sp^2	0.83
sp^3	0.04

Using absorption strengths from
Chiar et al. *ApJ* 2013, 770, 78

Comparison with observations in the diffuse ISM

Infrared Galaxy IRAS
08572+3915
Dartois et al. A&A 2007

Galactic center Quintuplet
Cluster.
Chiar et al. ApJ, 2013,

Comparison with observations in the diffuse ISM

Infrared Galaxy IRAS
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HAC 1 spectrum scaled to the
maximum

Galactic center Quintuplet
Cluster.
Chiar et al. ApJ, 2013,

Comparison with observations in the diffuse ISM

Infrared Galaxy IRAS
08572+3915
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HAC 1 spectrum scaled to the
maximum

HAC 2 spectrum scaled to the
maximum

Galactic center Quintuplet
Cluster.
Chiar et al. ApJ, 2013,

Deposit growth and structure

The H/C and sp^3/sp^2 ratios decrease with growing thickness

Processing in H₂ plasma

The CH_x stretch band decreases with processing

The CC stretch band remains unchanged

CC bonds polyaromatic rather than olefinic

Summary and conclusions

- Carbonaceous dust analogues have been grown in inductively coupled RF discharges of He+CH₄.
- The position in the plasma reactor affects the structure of the deposited hydrocarbon. Inside coil deposits are good analogues to interstellar medium dust.
- Processing with H₂ plasma do not affect the aromatic component of the carbonaceous material.

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