Fluorescence Spectroscopy of Gas-phase Polycyclic Aromatic Hydrocarbons

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Abstract

The purpose of this investigation was to produce fluorescence spectra of polycyclic aromatic hydrocarbon (PAH) molecules in the gas-phase for comparison with blue luminescence (BL) emission observed in astrophysical sources (Vijh et al. 2004, 2005a,b). The BL occurs roughly from 350 to 450 nm, with a sharp peak near 380 nm. PAHs with three to four rings, e.g. anthracene and pyrene, were found to produce luminescence in the appropriate spectral region, based on existing studies. Relatively few studies of the gas-phase fluorescence of PAHs exist; those that do exist have dealt primarily with the same samples commonly available for purchase such as pyrene and anthracene. In an attempt to understand the chemistry of the nebular environment we also obtained several nitrogen substituted PAHs from our colleagues at NASA Ames. In order to simulate the astrophysical environment we also took spectra by heating the PAHs in a flame. The flame environment counteracts the formation of dimmers and permits the spectroscopy of free-flying neutral molecules. Experiments with coal tar and coal tar extracts demonstrate that fluorescence spectroscopy reveals primarily the presence of the smallest molecules, which are most abundant and which possess the highest fluorescence efficiencies. One gas-phase PAH that seems to fit the BL spectrum most closely is phenanthridine, a 3-ring PAH with a single nitrogen substitution. In view of the results from the spectroscopy of coal tar, a compound containing PAH structures ranging from small, simple PAHs to very large PAH molecules, this fit in no way precludes the presence of larger PAHs in interstellar sources exhibiting BL.

References:
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