A New Molecular Model for the Carrier of the 2175 Å Interstellar Extinction Feature

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The constancy of the wavelength of the peak of the interstellar ultraviolet extinction feature (2175 Å 1 10 Å) can be explained by the presence of a repeating substructure in the form of an aromatic double ring, throughout a hydrocarbon molecular aggregate which is a component of interstellar grains. The quantum mechanical origin should make this aspect of the feature independent of grain size, unlike other models such as plasmon resonance. Other aspects of the overall molecular aggregate would explain the observed variation in breadth of the feature (the "bump"). This model was inspired by experiments where the simple polycyclic aromatic hydrocarbon (PAH) naphthalene ($C_{10}H_8$) is subjected to the energetic environment of a plasma, resulting in the synthesis of a molecular aggregate that has ultraviolet spectral characteristics that suggest it provides insight into the nature of the carrier of the 2175 Å interstellar extinction feature and may be a laboratory analog. Ultraviolet, visible, infrared, and mass spectroscopy, along with gas chromatography, indicate that it is a molecular aggregate in which an aromatic double ring ("naphthalene") structural base serves as the electron "box" chromophore that gives rise to the envelope of the 2175 Å feature. This chromophore can also provide the peak of the feature or function as a mantle in concert with another peak provider such as graphite. The molecular base/chromophore manifests itself both as a structural component of an alkyl-aromatic polymer and as a substructure of hydrogenated PAH species. Its spectral and molecular characteristics are consistent with what is generally expected for a complex molecular aggregate that has a role as an interstellar constituent, including infrared spectral character and realistic schemes for complex molecule formation in post AGB stars.

References:

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