

## DEVELOPMENT OF STRUCTURAL COMPLEXITY IN BARE AND HYDROGENATED CARBON CLUSTERS

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The importance of bare and hydrogenated carbon clusters in combustion and in the chemistry of interstellar space has motivated numerous spectroscopic studies, most of which have focused on smaller neutral and charged clusters with fewer than 10 carbon atoms and on the  $C_{60}$  and  $C_{70}$  fullerenes. Recently, we have obtained electronic spectra of bare and hydrogenated carbon cation clusters containing between up to 36 carbon atoms. Spectroscopically interrogating carbonaceous molecules containing more than 10 carbon atoms is complicated by the coexistence of different isomers possessing unique spectroscopic properties. To address this issue, we have developed an apparatus that allows formation and selection by ion mobility of a particular  $C_xH_y^+$  isomer population, which is incarcerated in a cryogenically cooled ion trap and subjected to tunable radiation. Resonant excitation of an electronic transition leads to cluster fragmentation, which when monitored as a function of wavelength, yields an action spectrum. We have used this approach to obtain electronic spectra for monocyclic  $C_n^+$  clusters with  $12 \leq n \leq 36$ , which exhibit sharp transitions that progressively shift to longer wavelength with increasing cluster size. We have also probed  $C_nH^+$  clusters, which are shown to exist as linear and cyclic isomers with distinct electronic spectra. Linear isomers ( $7 \leq n \leq 17$ ), feature sharp, intense absorptions across the UV and visible range, whereas cyclic isomers ( $n \geq 15$ ) have much weaker, and broader absorptions. Addition of more hydrogen atoms precipitates formation of bi-cyclic structures that may be precursors of polycyclic aromatic hydrocarbons.