New Measurements of Positron Annihilation on Molecules*

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Experiments have shown that low-energy (sub-eV) annihilation spectra of positrons on molecules are typically dominated by relatively sharp features that have been identified as vibrational Feshbach resonances (VFR) involving fundamental modes [1]. Further, in most molecules there is a broad spectrum of enhanced annihilation between the fundamentals, in the region of combination and overtone vibrational modes, where the density of modes is typically too high to identify discrete modes [2]. Ultimately, the experimental resolution of the spectrum is dependent on the energy resolution of the positron beam. Over the last several years, we have made a number of advancements in understanding the factors limiting the energy resolution of trapped based positron beams [3].

Several experiments will be described, including new measurements of positron binding energies for several alkane molecules with chlorine or oxygen substitutions. Also, annihilation spectra are compared for rings and chains using a room-temperature buffer-gas trap-based beam with improved energy resolution. It reveals anomalous broadening of the VFR structure for the ring geometry. We will describe the status of our cryogenic buffer-gas trap-based beam, which has the capability to increase the energy resolution by a factor of five [4]. Lastly, we will discuss the possibility of clarifying the role of combination and overtone modes in producing the broad background observed in positron annihilation spectra as a function of incident positron energy [5].

* Work supported by NSF grant PHY-1702230.

References

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