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Single photon ionization of hydrogen bonded clusters with a desktop size soft x-ray laser: $(\text{HCOOH})_n$ and $(\text{HCOOH})_m(\text{H}_2\text{O})_n$ SCOTT HEINBUCH, FENG DONG, JORGE ROCCA, ELLIOT BERNSTEIN, NSF ERC for Extreme Ultraviolet Science and Technology, Colorado State University — Pure neutral $(\text{HCOOH})_n$ clusters and mixed $(\text{HCOOH})_m(\text{H}_2\text{O})_n$ clusters are investigated employing time of flight mass spectroscopy and single photon ionization at 26.5 eV (from a soft x-ray laser). The distribution of pure $(\text{HCOOH})_n$ clusters is dependant on experimental conditions. At certain conditions a magic number is found at $n = 5$. During the ionization process, neutral clusters suffer little fragmentation because almost all excess energy above the vertical ionization energy is taken away by the photoelectron. Metastable dissociation rate constants of $(\text{HCOOH})_n^+$ are measured in the range of $(0.1-0.8) \times 10^4 \text{ s}^{-1}$ for cluster sizes of $4 < n < 9$. The rate constants display an alternating behavior between monomer and dimer loss that can be attributed to the structure of the cluster. When small amounts of water are added to the formic acid, the predominant signals in the mass spectrum are still $(\text{HCOOH})_n^+$ cluster ions. Also observed are the mixed cluster series $(\text{HCOOH})_m(\text{H}_2\text{O})_n$ for $m=1-8$ and $n=0-4$. A magic number in the cluster series $n=1$ at $m=5$ is observed. The mechanisms and dynamics of the formation of these neutral and ionic clusters are discussed.

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