

# Development of a Hybrid Miniature Ion Trap Mass Spectrometer and Ion Mobility Spectrometer for On-site Rapid Analysis of Peroxide-based Explosives and Illicit Drugs

---

Shuang Wang, Weimin Wang, Keyong Hou, Haiyang Li

*CAS Key Laboratory of Separation Sciences for Analytical Chemistry, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, 457 Zhongshan Road, Dalian 116023 P. R. China*

A hybrid miniature ion trap mass spectrometer and ion mobility spectrometer and has been developed for on-site rapid detection peroxide explosives and illicit drugs, its performances of quantitative analysis and accurate molecular identification were greatly enhanced by acquiring ion mobility spectrum and mass spectrum simultaneously for each real sample. The utilization of both mobility and  $m/z$  information of product ions could compensate the low resolution of the miniature mass spectrometer, and the high acquisition rate of ion mobility spectrometry could obtain high-resolution temporal information of different analytes in the thermal desorption unit, the hybrid spectrometer expands the peak capacity of a single analysis and enhances the quantitative ability and repeatability, which could help to reduce both positive and negative false alarm on-site rapid analysis of complicated samples. The hybrid spectrometer shares the same photoionization source and the temperature-controlled desorption unit for sample introduction. The ion mobility spectrum is acquired by a drift-tube ion mobility spectrometer with resolving power of 60-80, while the mass spectrum is acquired by a discontinuous ion trap mass spectrometer with a mass resolution about 2 Dalton. The dopant assisted photoionization source was based a commercial low-pressure krypton discharge lamp operated in both positive and negative mode. In positive mode, the reactant ions were protonated dimer ions of the organic dopants, its reactivity and selectivity could be tuned by select different dopants, such as acetone, butanone, etc. The total weight of the battery-operated hybrid spectrometer was less 16 Kg, 10 averaged ion mobility spectra and one mass spectrum per second could be obtained simultaneously. The analytical performances of the hybrid spectrometer are demonstrated by rapid analysis of triacetone triperoxide (TATP) and hexamethylene trioxide diamine (HMTD) in some common soft drinks.