Breakthrough by superconducting particle detector in mass spectrometry

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Mass spectrometry (MS) is defined as a method to analyze ions that are accelerated by a potential difference (V) according to mass/charge-number (m/z) ratios. The m/z peak identification always requires the speculation on the ionic charge state. This is one of the fundamental limits of MS. Other MS limit is that there is no way to distinguish different neutral molecules, because neutral molecules exhibit no response to electromagnetic field. It is called neutral loss. The neutral loss turns into an issue in tandem mass spectrometry (MS/MS), in which precursor ions selected by the first MS dissociate into fragments through atomic collision or other dissociation processes and analyzed by the second MS.
The MS fundamental limits can be overcome by using superconductivity for the molecule detection with phonon-mediated quasiparticle breaking by particle impact. The superconducting detectors have the capability of kinetic energy (KE) measurement for particle impact in a low energy range of keV. The KE of an ion is expressed by zV, so that the KE measurement enables z-value determination and thus unique mass measurement is possible.[1] The KE measurement is also effective for separating different neutral molecules in MS/MS.[2]

[1]S. Siki, et al., J. Mass Spectrom. **43**, 1686 (2008).
[2]M. Ohkubo, et al., Int. J. Mass Spectrom. **299**, 94 (2011).

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