The Pixel Imaging Mass Spectrometry sensor – functionality, performance, and a variety of applications

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The Pixel Imaging Mass Spectrometry (PImMS) sensor [1] is a CMOS-based imaging sensor that has been developed by a collaboration of groups from Oxford Chemistry, Oxford Physics, and the Rutherford Appleton Laboratory for application in time-of-flight (tof) mass spectrometry. It is implemented in a camera after the MCP/phosphor screen detector of a tof spectrometer. Each time a light flash from the phosphor reaches the sensor, the affected pixel stores a time stamp that contains the spatial position of the pixel together with the time of the event with respect to a trigger signal. The sensor currently operates on a 12.5 ns clock cycle that defines the timing precision, which is enough to differentiate between isotopes. Furthermore, each individual pixel can record up to four time stamps per acquisition cycle, avoiding shadowing effects for later ions. We present details of the functionality of the sensor as well as results of the performance characterisation.

Applications of the PImMS sensor include spatial imaging mass spectrometry [2], where the spatial position on the sample from where the ions originate is directly projected onto the detector; this allows for instance imaging the location of metabolites in tissue samples [3]. Velocity-map imaging [4] is another important application field, where the initial velocity is mapped onto the two-dimensional detector, and allows insights in both the angular and the kinetic energy information. A special case is photoelectron-photoion coincidence [5], where electrons and ions originating in the same photoinduced molecular process are imaged in coincidence. Very recently, the PImMS sensor has been employed for the first time in the context of ion-ion covariance analysis [6]. We present examples for all those applications of the PImMS sensor.

References:

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