

Miniature QMF and LIT using LBMT for HEMS Applications

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We present the design, construction and test results of a quadrupole mass filter (QMF) and linear ion trap (LIT), both fabricated using Digital Light Processing (DLP), which is a low-cost 3D Layer Based Manufacturing Technique (LBMT). LBMT's are a class of rapid manufacturing technologies, which allow digital manufacture at the microscale without the need for expensive tooling. Instead of removing material via a reductive process, there is a repetitive addition of material in a layer wise manner. An advantage of DLP is that smooth, lightweight, electrode structures of any geometry may be quickly realized at low cost. Both the QMF and the LIT were fabricated with hyperbolic profiles. The QMF was incorporated into a portable residual gas analyzer and was used to obtain hydrogen and helium spectra in the 1-6 Da mass range with a resolution of 70. The LIT was incorporated into a portable mass spectrometer system and experimental mass spectra were obtained for methamphetamine ($m/z=150$), cocaine ($m/z =182,304$) and rhodamine B ($m/z = 443$) with a resolution of 246. For rhodamine B, tandem MS capability was also demonstrated. The mass range (and resolution at large m/z) of the LIT was demonstrated by spectra obtained from ultramark 1621 ($m/z < 1900$). The spectra obtained for the DLP trap occur at a considerably lower RF voltage than a rectilinear ion trap of similar size, which is a consequence of the hyperbolic electrode geometry in the DLP case. Low voltage operation is especially important with regard to harsh environment applications requiring low power consumption for extended periods of operation.