Redesign of the Construction and Increase in the Performance of the Peripheral Devices of a Micro Mass Spectrometer

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The Planar Integrated Micro Mass Spectrometer (PIMMS) presented by Hauschild et. al. (HEMS 2007) has been partly redesigned and its peripheral devices further improved in performance and size. The microplasma used for ionization has been optimized such that the electron extraction current increases by one order of magnitude from ~2.5 μA to ~37 μA. Impedance matching and waveguide length reduction has allowed an RF power reduction down to ~200mW. By using the printed circuit board (PCB) for the PIMMS module as a vacuum-tight flange (Vacuum-PCB) for the vacuum vessel, the evacuated volume has been reduced to 0.5L. The backside of the Vacuum-PCB is used to make electrical, sample and plasma gas connections to the PIMMS. Gases are fed into the PIMMS through capillaries and valves which are spatially separated from the electronics. The two-channel signal generator previously used for the synchronous-ion-shield (SIS) separator has been replaced by a new four-channel one with a signal rise time <1ns for a 1pF load. The rectangular signals can be swept in the range DC-70MHz with a resolution smaller than 0.1Hz. The strategic placement of the generator on the vacuum-PCB allows the rectangular signals to arrive virtually undistorted at the finger electrodes of the SIS separator. The ion current measurement takes place in the immediate vicinity of the detector in the PIMMS, making it insensitive to vibrations and improving its time response (τ = 3ms). This high input impedance circuit is located on the PIMMS module and converts the ion current (pA range) into a proportional voltage which is then measured at the backside of the vacuum-PCB. The combination of these improvements has led to an increase in the performance of the PIMMS, making it able to measure concentrations <1%. The total volume of vacuum vessel and pumping unit is 4.5L and weights 5kg.