SHRIMP

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Sensitive High Resolution Ion Micro Probe (SHRIMP) is a large double focussing secondary ion mass spectrometer (SIMS) created for micro isotopic analysis of the geological samples. The SIMS instrument comprises the following components: probe beam, interaction chamber, mass spectrometer and detection system.

Probe beam – The probe beam is almost a beam of molecular oxygen negative ions, O^-_2. The O^-_2 is created from neutral oxygen gas inside duoplasmatron source. These negative ions O^-_2 are pulled out the duoplasmatron and accelerated to target (sample) with an energy of 10 000 electron Volts (eV) equivalent to 884000 Km per hour.

Interaction Chamber – The primary beam particles O^-_2 coming in hits the sample in high speed. This means that the sample is sputtered at a constant ion beam rate. The diameter of the probe beam is determined by Köhler aperture and the ranges are variable from 5μm to 35μm. When the probe beam hits at an angle of 45 °C onto the target (sample), knocks off ("sputters") which is some way related to the sample. The crater size produced on zircon sample, after 15 minutes of analysis, is typically 20 x 25 x 1μm deep. Some of this stuff is ionised and this is called secondary ions. This secondary beam then is accelerated into the mass spectrometer with negative high tension (10000 Volts).

Mass spectrometer – The secondary ions are analysed by combination of the Electrostatic Analyser (ESA) – for energy analysis and Magnetic Analyser (MA) – for mass analysis. This arrangement is known as double focussing system. Besides ESA and MA the SHRIMP possess a lot of lens, slits and monitors. The secondary ion beam way schematic is Extraction lens → quadrupole lens → secondary beam monitor → source slit → alpha slits → ESA → energy slit → quadrupole lens → hall probe → collector slit → retardation lens → mass detection. The ESA comprises an 85° cylindrical electrostatic analyser with radius of 1272 mm while MA comprises by a 72,5° magnet sector with radius of 1000 mm. Mass resolution defined as M/ΔM is measured at 1% of the mass peak height, is typically 5500 with flat topped peaks. The magnet field necessary for ^{238}U is around 2222.5 G.

Detection system – SHRIMP II has a single Faraday cup and electron multiplier coupled with particles counter. Depending on magnitude of the signal, the number of secondary ions flying out magnet into the collector, the ions can be detected and measured of two ways: a) Faraday cup → continuous measurement of the secondary ion current; b) Ions counting → detecting each and every ion flying into detector (very low signal). Optionally can be coupled multi detector type chaneltron.

Final considerations: SHRIMP is a spectrometer with high mass resolution coupled as ion micro probe able to analyser in situ a small portion of the zircon, and therefore, can measure distinct crystal regions, such as, core and overgrowth rim. The concordant ages can be obtained directing probe beam at not disturbance / recrystallisation zircon region. When oscillatory zoned zircon appears damaged in cathodeluminescence images yield discordant ages.