

Claims

1. Mass spectrometer (1), comprising:
 - a gas inlet (2) adapted to supply a sample gas (4) to be ionized to an ionization region (5) of the mass spectrometer (1),
 - a calibration unit (6) adapted to supply a calibration gas (7) to be ionized to the ionization region (5),
 - an ionization unit (8) adapted to ionize the sample gas (4) and/or the calibration gas (7) in the ionization region (5), wherein
 - the calibration unit (6) comprises at least one evaporation source (9) for generating the calibration gas (7) by evaporating a source material (10).
2. Mass spectrometer according to claim 1, wherein the source material (10) and the ionization region (5) are arranged along a line of sight (14a).
3. Mass spectrometer according to claim 1 or 2, wherein the evaporation source is a thermal evaporation source (9), preferably a resistive evaporation source, an electron beam evaporation source or an effusion evaporation source.
4. Mass spectrometer according to claim 3, wherein the resistive evaporation source (9) comprises a heated filament (26) that is at least partially coated with the source material (10).
5. Mass spectrometer according to claim 1, wherein the evaporation source (9) is a pulsed laser deposition, PLD, evaporation source.
6. Mass spectrometer according to any one of the preceding claims, wherein the source material (10) is a metal, preferably selected from the group consisting of: Al, Co, Mn, Bi, Ni, Fe, Cu and precious metals, in particular Au.
7. Mass spectrometer according to any one of claims 1 to 5, wherein the source material (10) is selected from the group consisting of: metal nitrides and metal oxides, in particular of Tantalum, Vanadium, Tungsten, Rhenium, or Yttrium.

8. Mass spectrometer according to any one of the preceding claims, further comprising:
at least one sensor (15a, 15b), preferably for determining a pressure (p_c) of the calibration gas (7), wherein the sensor (15a, 15b) is preferably arranged along a line of sight (14a) to the ionization region (5) and/or along a line of sight (14a, 14b) to the source material (10).
9. Mass spectrometer according to claim 8, wherein the sensor is a pressure sensor (15a), preferably an ionization vacuum gauge (15b), more preferably a cold cathode vacuum gauge, in particular a Penning vacuum gauge, or a hot cathode vacuum gauge, in particular a Bayard-Alpert vacuum gauge or an extractor ionization gauge.
10. Mass spectrometer according to claim 9, wherein the pressure sensor (15a, 15b) or a control unit (13) of the mass spectrometer (1) is adapted for determining a flow rate (Q_c) of the calibration gas (7) based on the pressure (p_c) of the calibration gas (7) determined by the pressure sensor (15a).
11. Mass spectrometer according to any one of claims 8 to 10, wherein the sensor (15b) is a quartz crystal microbalance, preferably for determining a flow rate (Q_c) of the calibration gas (7).
12. Mass spectrometer according to any one of claims 8 to 11, further comprising: a movable cover (16) for blocking a line of sight (14a) between the source material (10) and the ionization region (5) and/or a line of sight (14b) between the source material (10) and the pressure sensor (15b).
13. Mass spectrometer according to any one of the preceding claims, wherein the ionization unit (8) is an electron ionization source.
14. Mass spectrometer according to any one of the preceding claims, further comprising:

an ion trap (18) for storing ions (7a, 7b) of the sample gas (4) and/or of the calibration gas (7), wherein the ionization region (5) is formed inside of the ion trap (18).

15. Method for calibrating a mass spectrometer (1), comprising:

generating a calibration gas (7) by evaporating a source material (10) in at least one evaporation source (9) of the mass spectrometer (1),
supplying the calibration gas (7) to an ionization region (5) and ionizing the calibration gas (7) in the ionization region (5),
detecting the ionized calibration gas (7) in a detector (12) of the mass spectrometer (1), and
calibrating the mass spectrometer (1) based on the detected ionized calibration gas (7).

16. Method according to claim 15, wherein the step of calibrating the mass spectrometer (1) comprises:

determining a sensitivity (K_k) of the mass spectrometer (1) based on a signal intensity (S_k) of the detector (12) when detecting the ionized calibration gas (7) and based on a pressure (p_c) detected by at least one pressure sensor (15a, 15b) when supplying the calibration gas (7) to the ionization region (5).

17. Method according to claim 15 or 16, further comprising:

before and/or after supplying the calibration gas (7) to the ionization region (5):
coating surfaces (3a) of vacuum components (3) in the mass spectrometer (1) with a getter material (17) for the source material (10).