

to ionize as large a proportion as possible of the not yet ionized analyte molecules in the plasma cloud by proton transfer from the matrix substance ions to the analyte molecules.

[0038] Only a tiny fraction of the sample (23) with preferably less than one picogram of sample material is desorbed in the spot of the laser beam (25) from the laser (24), which is deflected onto the sample (23) by the mirror (26). The lenses required for focusing the beam of laser light to a spot are not shown in FIG. 2. The laser (24) used in this embodiment is preferably a pulsed UV laser, which delivers short pulses of laser light of less than 0.5 picoseconds duration; every pulse of laser light generates its own desorption cloud of analyte ions (27), but their rapid succession leads them to merge together and provide the constant ion current. The UV laser preferably operates in the wavelength range between approximately 310 and 360 nanometers.

[0039] The mirror (26) should be movable through very small angles very quickly in order to move the laser light spot over the sample between laser shots. This allows the vaporization crater to cool down again by heat dissipation after each laser shot. The motion can be brought about by gluing the mirror onto a piezoelectric crystal, for example. The piezoelectric crystal can be two-dimensionally excited to its resonance frequencies. The mirror then follows the oscillations and moves the spots at high speed. Moreover, the movement of the sample support plate can contribute to the distribution of the spots over the sample. The use of a mirror with a galvanometric drive is also possible.

[0040] The ion funnel (28) consists of a series of apertured diaphragms to which the phases of an RF voltage are applied in turn, thus creating an ion-repelling pseudopotential on the virtual wall of the funnel-shaped interior. A series of DC voltages are superimposed on the RF voltage, which draw the ions into the ion funnel and guides them to its narrow end. At the end, the funnel passes into an ion guide comprising apertured diaphragms (29). The two phases of an RF voltage, on which a DC potential gradient is superimposed, are applied in turn to the apertured diaphragms (29). A lens system (30) then guides the ions into the multipole rod system (31), which guides the ions to the analyzer.

[0041] The ion guide (31), which serves here to collect the analyte ions from the ion source according to the invention, is shown here simply as one example of a system which can collect the analyte ions and, if necessary, transmit or temporarily store them. As illustrated in FIG. 2, the ion guide can consist of pole rods supplied with an RF voltage. It can, but does not have to, transmit the analyte ions into the analyzer section of the mass spectrometer, where they are analyzed according to their mass and intensity. Any other suitable type of spectrometer can be used in place of a mass spectrometer for the analysis of the analyte ions, for example an ion mobility spectrometer or an optical spectrometer.

[0042] The vaporization of the sample materials in the spots can also take place directly into the axis of a multipole rod system, with the pulse of laser light being injected through the spaces between the pole rods. In this case it has proved favorable to blow a little gas through a capillary onto the sample on the sample support so that a slightly higher pressure of between one hundredth and one tenth of a Pascal is obtained in front of the sample. This increases the yield of analyte ions again.

[0043] As already noted above, the conventional matrix substances and methods of preparation can be used to prepare

the samples (22, 23). The samples on the sample supports usually have diameters of between 200 micrometers and two millimeters. Pre-prepared thin layers of matrix material are available with diameters of the coatings of 800 micrometers, for example. Thin layers are preferably produced using α -cyano-4-hydroxycinnamic acid (CHCA). The thin-layer coatings are located in regions of the sample support plate that are highly hydrophobic. The samples can then be applied in dissolved form to the thin layers on the sample support plate using pipetting robots and dried in situ, or, better, the liquid can be taken up again after a short time. If thin layers are not used, but instead 2,5 dihydroxybenzoic acid (DHB), sinapic acid (SA) or 3-hydroxypicolinic acid (3-HPA) for example, then special hydrophilic areas on the sample support plate in hydrophobic surroundings can, in particular, limit the sample crystallization to these hydrophilic areas. A large number of matrix substances have been elucidated which are each matched to certain groups of analyte substances which they ionize particularly well.

[0044] For imaging mass spectrometry using histologic thin sections, the coating methods for matrix materials developed especially for this technique can also be used. At present, imaging mass spectrometry is mostly carried out with axial MALDI time-of-flight mass spectrometers. The short-time MALDI according to the invention promises improved detection limits with the same duration of the scanning process for recording spectra. Time-of-flight mass spectrometers with orthogonal ion injection are also interesting for this purpose because the scanning of the samples promises to be many times faster than with conventional MALDI time-of-flight mass spectrometry.

[0045] The ion sources according to the invention can be used in mass spectrometers of various types, and also in quite different types of spectrometer, for example ion mobility spectrometers. Also of particular interest is, for example, an application as the highly sensitive ion source in a tandem mass spectrometer, which uses a quadrupole filter as the first separation technique and a time-of-flight mass analyzer with orthogonal ion injection (Q-OTOF) as the mass analyzer. This type of mass analyzer has maximum sensitivity, large dynamic measuring range, and an outstanding mass accuracy, also for daughter ion spectra. The fragmentation unit can be either a collision cell or any other fragmentation stage.

[0046] This example is only one of many, however. It would also be possible to list additional spectrometric applications here. With knowledge of this invention, the specialist can create further obvious embodiments and applications, which will, however, always be governed by the fundamental idea of the invention and hence should be included in the scope of protection.

What is claimed is:

1. A method for generating analyte ions by matrix-assisted laser desorption of a sample which contains analyte molecules together with molecules of a matrix substance, comprising:

- (a) producing with a pulsed UV laser, pulses of laser light, each pulse having a pulse duration of less than one nanosecond, and
- (b) focusing the pulses of laser light onto at least one spot on the sample, which spot has a diameter of less than twenty micrometers in order to desorb sample material from the sample and generate the analyte ions.

2. The method according to claim 1, wherein step (a) comprises adjusting the laser to produce an energy density in each