

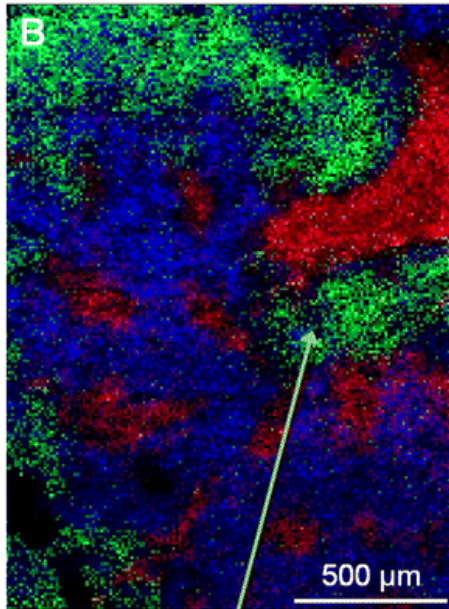
Schriftliche Prüfung Moderne MS Winter 2013/2014

Vorname : _____ Name : _____

- Zeit: 60 Min. Teilen Sie sich Ihre Zeit gut ein.
Time: 60 min, organize your time carefully.
- Sie können auf Englisch oder Deutsch antworten
Answers are accepted in German or English.
- Es sind alle Hilfsmittel mit Ausnahme von Computern und Telekommunikation erlaubt.
It is allowed to use all resources except for computers and communication devices.
- Unleserliche Texte, unklare Formulierungen oder unsaubere Skizzen können nicht bewertet werden. Bitte bemühen Sie sich um eine saubere Darstellung.
Unreadable text, unclear formulations or graphs are not graded. Please try to use clear illustrations and descriptions
- Schreiben Sie jedes abzugebende Blatt einzeln mit Ihrem Namen und Vornamen an.
Label every page with name and surname.
- Dieses Deckblatt ist ausgefüllt abzugeben. Die Aufgabenstellung ist ebenfalls einzureichen.
Please fill in the first page. Hand in all pages including cover page and questions.
- Wir bitten Sie um Fairness und wünschen Ihnen viel Erfolg!
We ask you for fairness and wish you good luck!

Prüfungsaufgabe Wintersession 2014

An active area of research in mass spectrometry (which was not treated in the lecture) is imaging. The trend in this area is to get to ever higher spatial and mass resolution, while keeping the sample at ambient conditions. The image below shows MS imaging of the distribution of a drug (imatinib, a cancer drug) in a mouse kidney that was cut into thin sections.



B Overlay of selected ion images:

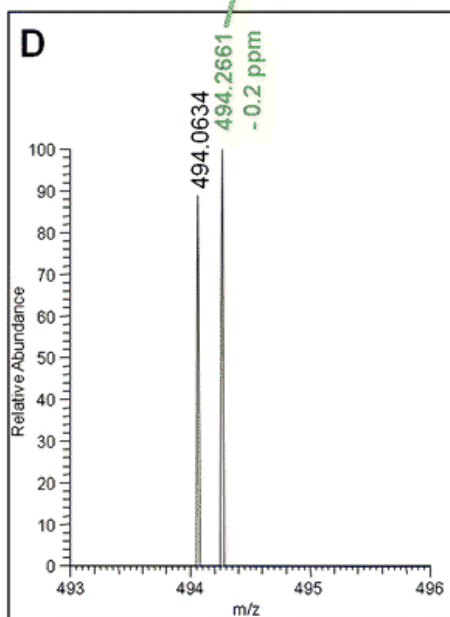
green, imatinib $[M+H]^+$ = 494.2662 m/z outer stripe outer medulla (medulla = the inner, darker portion of the kidney parenchyma consisting of the so-called kidney pyramids);

blue, $[PC(38:5)+K]^+$ = 846.5410 m/z inner stripe outer medulla;

red, $[heme\ b]^+$ = 616.1767 m/z vasa recta (= peritubular capillaries in the kidneys that are situated parallel to and surrounding the loop of Henle); MS image, bin width $\Delta m/z = 0.01$.

D Single-pixel mass spectrum of the outer stripe outer medulla of mouse kidney section.

Source: A. Römpp et al., *Analyt. Bioanal. Chem.* **401** (2011) 65–73.



Answer the following questions:

- Estimate the spatial resolution reached by this mass spectrometric imaging method based on image **B**.
- Suggest an ionization method that could reach such a spatial resolution, and elaborate on the sample preparation that you would carry out (*after* thin sectioning of the tissue).
- What are the limiting factors for reaching even higher spatial resolution (e.g., for nanoscale imaging)? Substantiate your answer with physical/chemical arguments.
- What mass resolving power is necessary to distinguish the signal of protonated imatinib in **D** from an interfering signal at the same nominal mass?
- What mass analyzer was probably used in this case?
- Imagine that you would have to measure the spatial distribution of a metalloprotein in the same tissue thin section. What alternative method would you use in this case, and how would the sample preparation and analytical figures of merit (spatial resolution, mass resolution, etc.) differ from the above in this case?