**Project name:** Correlation between chemical structure of urinary sediments and kidney stones

# Beamtime Report

**29.04.2013 – 03.05.2013** *(Date of the report to be added)*

## General information

| Name of the rapporteur | Name of the rapporteur's organisation |
|---|---|
| Sonata Varvuolyte | Baltupių šeimos medicinos centras |
| **Type of research (nanotechnology/health care/chemistry etc.)** | **Name of the research facility** |
| Health care | MAX IV laboratory, Lund university |
| **Date of the measurement, duration** | **Location of the event** |
| 2013-04-29 – 2013-05-03 (5 days) | D7 (infrared spectroscopy) beamline, MAX IV laboratory, Lund university |
| **Facility personnel participating in the measurement** | |
| Dr.Anders Engdahi, Prof. Per Uvdal | |

## Description of the project

| Research description (short summary as written in the application) |
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| **Scientific problem:**<br>Nephrolithiasis is worldwide disease and its prevention is an actual problem of nowadays medicine.<br>**Solution of the problem:**<br>To find some indicators of kidney stones formation in very early stages of the process.<br>**Idea of the project:**<br>To find correlation between chemical structure of urinary sediments and kidney stones. Formation of the stones is usually initiated by oversaturation of urine with stones forming materials what should be followed by increased amount of urinary sediments. Theoretically, infrared microspectroscopy is capable to identify chemical structure of the sediments, but practically, brightness of conventional globar source of commercial infrared spectrometers is not bright enough in case of experiments with such small samples as urinary sediments, which size is in the range of 5-10 microns. Use of such bright infrared source as synchrotron radiation instead of globar would allow obtain chemical information about urinary sediments and to compare chemical structures of the sediments and the stones removed from the same patients. |
| **Summary of activities (experiments performed, beamtime used, preliminary overview of results, next steps and other relevant information)** |
| During the project period, primary experiments to evaluate the potential of synchrotron based infrared microspectroscopy method for investigation of micro-scale urinary sediments were implemented. During the research period 20 samples of the sediments were investigated. For each specimen of urine, the sediments were filtered and transferred on ZnSe optical window for investigation by means of infrared |

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| microspectroscopy.<br>Sediments of micro-scale dimensions (10 – 100 μm) were investigated. The illumination region was confined to obstruct the infrared (IR) radiation from surrounding stray light and to keep IR reaching only the area of the sample by glass windows. Both globar and synchrotron radiation illumination were used to evaluate whether illuminating by synchrotron radiation allows investigating smaller sediments. Keeping appropriate S/R is important for qualitative evaluation of spectra.<br>The results showed the use of synchrotron radiation to be better than that of a globar for investigation of micro-scale urinary sediments. The particular result was expected due to intensity distribution of the synchrotron radiation with the highest intensity confined in a small spot in the centre of the illuminated area. Thus, when physically confining the illumination regions for investigation of very small samples the signal was sufficient to collect the infrared spectra; meanwhile, it was too much reduced when globar radiation was used. Fig. 1 (a) (see Annexes) shows the optical image of confined sediment keeping only 10 × 10 μm of illumination area. The recorded spectrum of the particular sediment shows it to be calcium oxalate monohydrate as shown in Fig. 1 (b). The S/N ratio of the spectrum recorded by using globar radiation of the same sediment was too low for appropriate quantitative evaluation. Main kidney stones forming materials were found as constituents of urinary deposits: calcium oxalate, uric acid, brushite, struvite, various apatites and organic sediments.<br>The research proved the potential of using synchrotron radiation based infrared microscopy for investigation of micro-scale urinary sediments whenever their size is too small for conventional globar illumination source. Thus, very detailed information about chemical composition of urinary deposits could be obtained and used for kidney stones' prevention purposes. By studying the chemistry of small sediments, which is hardly obtainable by conventional methods, more detailed insights to kidney stone formation processes could be gained as well.<br>The research should be extended to larger scale by investigating more samples for statistical evaluation. Sediments of healthy and kidney stone patients should be investigated for combined comparison of dimensions and chemistry of both cases. The appropriate tuning or enhancement of the system could be done in order to achieve even smaller lateral resolution. |
| **How would you describe cooperation and assistance from industrial liaison officers and national contact points while preparing and carrying out the research at large scale facilities?** |
| The opportunity to participate and collaborate in such scientific activity for primary health care gives as a possibility to re-evaluate the meaning and influence of science in practical every day clinical work as a chance to make changes in concrete disease early detection pattern and create future scientific based disease prevention advice for patients. |
| **Other personal remarks** |
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## Annexes

| **Annexes** |
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(list of annexes; meeting minutes, graphical illustrations, tables and other supplementary data)

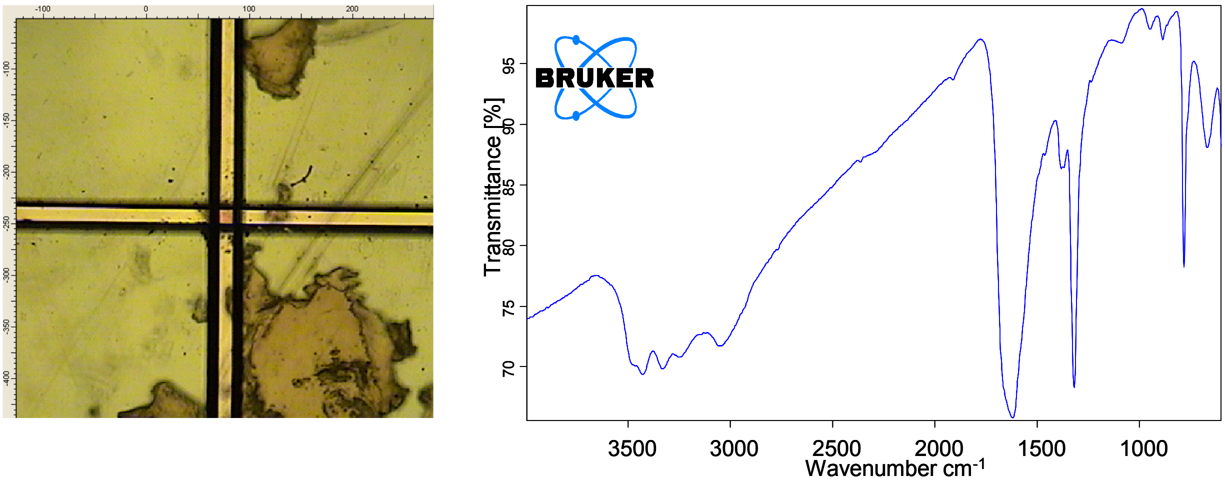


Fig. 1 (a) Optical image of urinary sediment confined by glass windows. Thus the illumination area is limited to 10 × 10 µm. (b) Transmission spectrum of the urinary sediment corresponding to calcium oxalate monohydrate.