

## MICROTOMOGRAPHY OF RENAL CALCULI

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The aim of the study was the investigation of renal calculi structure with the use of microtomography utilizing synchrotron radiation. Two problems were considered: (1) if the renal calculi developed in the first and second nephrolitiasis episodes have similar microstructure and (2) are there differences between the structure of stones which elemental composition is different from the average renal calculi population.

The renal calculi developed in the first and second nephrolitiasis episodes were collected from three patients in a standard medical procedures applied in nephrolitiasis (6 samples). A pieces of the stones with dimensions suitable for the microtomographic measurements were prepared and measured.

Additionally the samples of renal stones with unusual elemental composition were choosen and prepared for measurements. The elemental composition was previously investigated by IR spectroscopy. The cases characterised by unusuall concentrations of Mg, Ca and S were taken into consideration (5 samples). The structure as weel as the density distributions are considered so the density standard was also investigated. The standard was preparted as the pastille-sandwich made from 5 layers of substances observed in typical renal stones (uric acid, hydroxyapatite, struvite, cysteine and calcium oxalate) (Fig. 1).

Finally, twelve samples were investigated (eleven renal stone pieces and one density standard). The beamline BW2 on HASYLAB Hamburg, Germany) equipped with microtomographic scanning system was utilized. The energy of 21 keV was applied. Achieved image resolution was about 7.6  $\mu\text{m}$ . The 3D images of investigated samples were reconstructed (each of about 2 GB large) and analyzed. Achieved voxel size in reconstructed images is about 4  $\mu\text{m}$  and Fig. 2. The sample of reconstructed images is presented in Fig. 2.

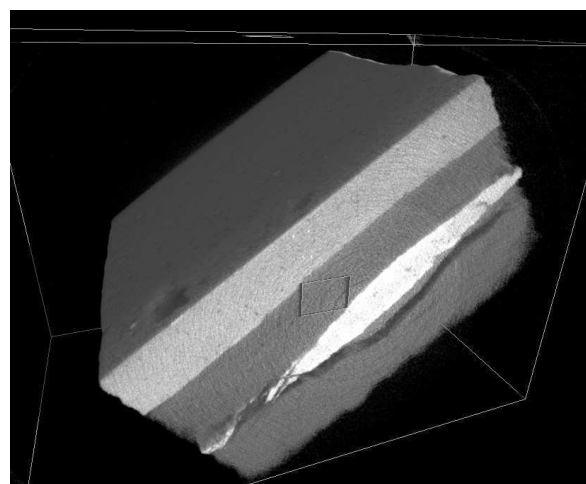


Figure 1. The reconstructed 3D image of investigated density standard. The structure of sandwich layers is well visible.

The quantitative analysis of collected data is still in progress but first conclusions can be drown. The assumption that the renal calculi developed in the first and second stage of nephrolitiasis have different structures was not confirmed. The differences could be caused by the treatment and diet introduced for patients after first nephrolitiasis occurrence. Only in one pair of the renal calculies developed in the first and second nephrolitiasis episodes distinct differences were observed (Fig. 3).

The microstructure of renal calculies representing unusual elemental compositions differs from the average population but the parameters describing quantitatively the microstructure have to be developed in order to draw reasonable conclusions.

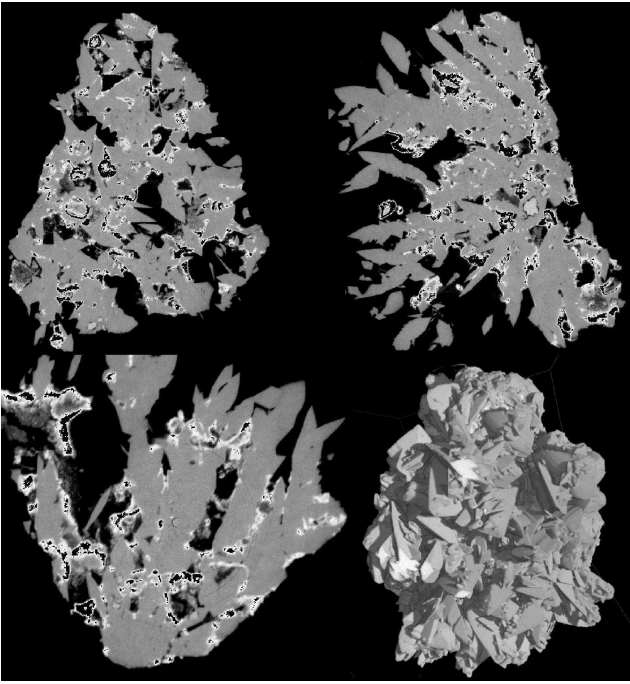


Figure 2. The reconstructed 3D image of a renal calculi sample and its cross sections in orthogonal directions.

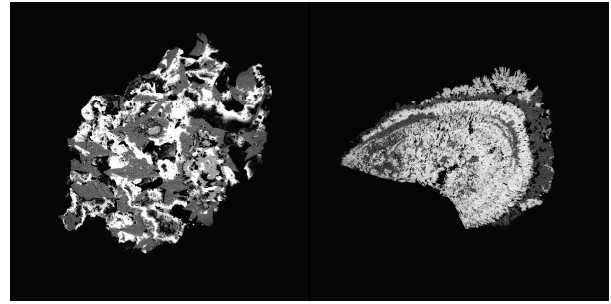


Figure 3. The cross-sections through the reconstructed 3D microtomographic images of two renal calculi samples. The sample collected during the first episode of recurrent nephrolithiasis is shown on the left while the cross-section of the second episode is presented on the right. Brighter areas represent regions characterised by higher densities.

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