

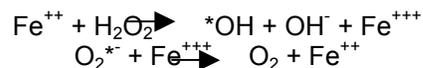
## Prostate Tissue Sections Analyzed By Synchrotron Radiation

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Abstract No. Kwia8511

Beamline(s): X26A

**Introduction:** Prostate cancer disease is the most common disease among men. The understanding of its genesis is not very well known and therefore this kind of investigation has been performed. It is known that the cancerous process involves oxygen. The Fenton Reaction may explain the production of free radicals that are responsible for the carcinogenic process. The Fenton Reaction consists of two co-operative stages:



As a result of this reaction the increase of hydroxide radical ( $\cdot\text{OH}$ ) concentration is observed. This type of radical is the most active oxidizing agent that is able to induce mutation of DNA in vivo. The Fenton reaction speed depends on availability of iron ions. The availability of iron is required for proper division of normal and cancerous cells. The tumor growth depends on iron concentration and is faster in rich-iron environment. The use of Synchrotron Radiation Induced X-ray Emission (SRIXE) and X-ray Absorption Near Edge Structure (XANES) enabled obtaining additional information about the prostate cancer.

**Methods and Materials:** The prostate tissue sections were obtained after radical prostatectomy. The samples were histologically examined and classified as cancer of the prostate with the Gleason score of 8. A 10  $\mu\text{m}$  thick tissue sections cut on a cryo-microtome were placed on 3  $\mu\text{m}$  thin Mylar foil and were irradiated with monochromatic X-ray beam of 16  $\mu\text{m}$  x 14  $\mu\text{m}$  size. The two-dimensional scans on both cancerous and non-cancerous parts of the tissue were made in order to determine trace element concentrations and iron oxidation state.

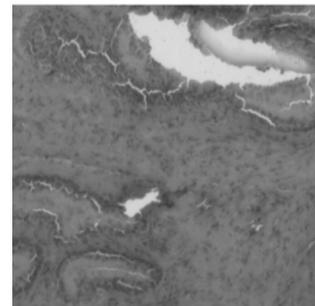
**Results:** The results obtained show the difference in concentrations of zinc and iron. Zinc is decreased by factor of 6.5 while iron is increased by factor of 3 in cancerous parts of the prostate tissue in comparison to non-cancerous parts. Pictures show two-dimensional scans of the tissue sections highlighting specific trace elements. As one can see the chlorine distribution corresponds to tissue structure. Iron is not uniformly distributed. White colour corresponds to the highest concentration of the element. In case of iron white spots also indicate iron in 3<sup>rd</sup> oxidation state.

**Conclusions:** Zinc is decreased while iron is increased in cancerous parts of the prostate tissues. Iron appears in 3<sup>rd</sup> oxidation state in cancerous tissues while the non-cancerous parts contain iron mostly in 2<sup>nd</sup> oxidation state.

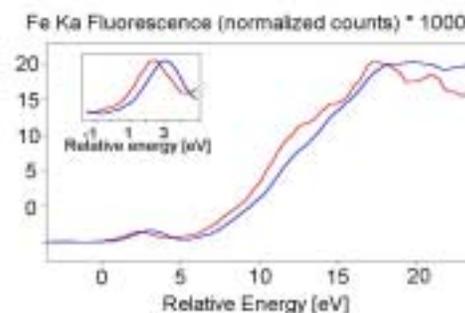
**Acknowledgments:** The authors wish to thank to Prof. Jerzy Stachura and his co-workers for their help and work done in sample classification due to cancer cell definition. This work has been supported by State Committee for Scientific Research (KBN), Poland Grant No. IFJ0202 and the National Synchrotron Light Source, General User Grant No. 3680.

**References:** B. Halliwell, JMC. Gutteridge, "Oxygen toxicity, oxygen radicals, transition metals and disease", *Biochemistry Journal*, **219**,1-14,1984.

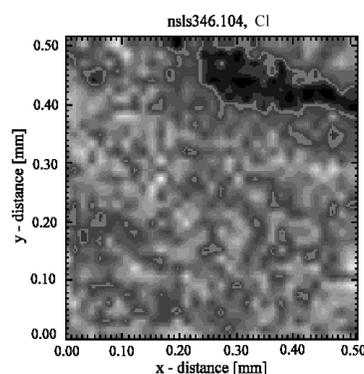
L. Magos, "Epidemiological and experimental aspects of metal carcinogenesis". *Environ Health Prospect*, **95**,157-89, 1991.



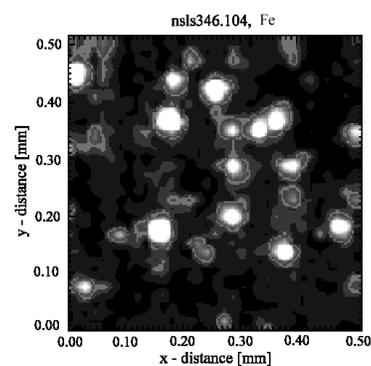
**Figure 1.** View of the stained prostate tissue section.



**Figure 2.** XANES spectra of two different spots on prostate tissue (red-non-cancerous, blue-cancerous).



**Figure 3.** 2-dimensional scan showing Cl distribution over the tissue section presented in fig.1.



**Figure 4.** 2-dimensional scan showing Fe distribution over the tissue section presented in fig.1