Application of the Rutherford ion backscattering spectrometry method in powder nanotechnology: YSZ – system.

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Introduction

Rutherford Backscattering Spectrometry (RBS) is an ion scattering technique used for compositional thin film that are less than 1μm thick analysis. During an RBS analysis, high-energy He^{2+} ions with energies in the region from several hundred kiloelectron-volts to 2 - 3 MeV are directed onto the sample and the energy distribution and yield of the backscattered He^{2+} ions at a given angle is measured.
Since the backscattering cross section for each element is known it is possible to obtain a quantitative compositional depth profile.

The capabilities of this method can be significantly expanded. In particular, the method can be used in powder nanotechnology to study elemental composition in microscopically small objects.

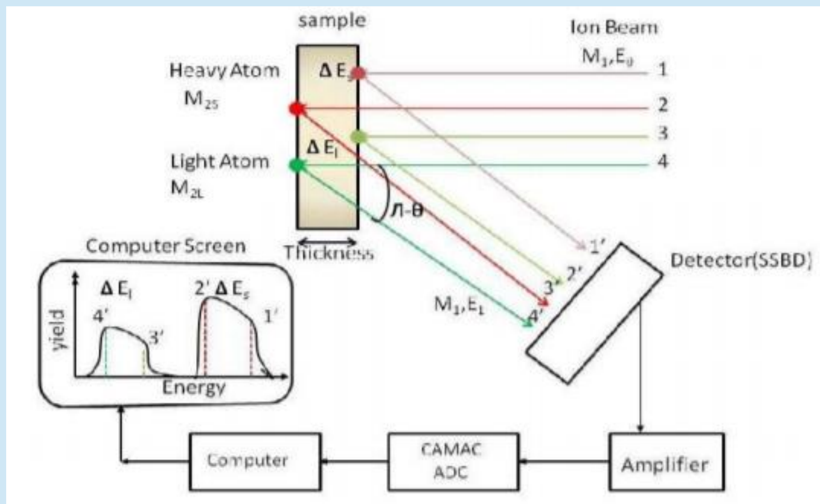

Figure.1. Schematic diagram of RBS facility [2].

Methods and Materials

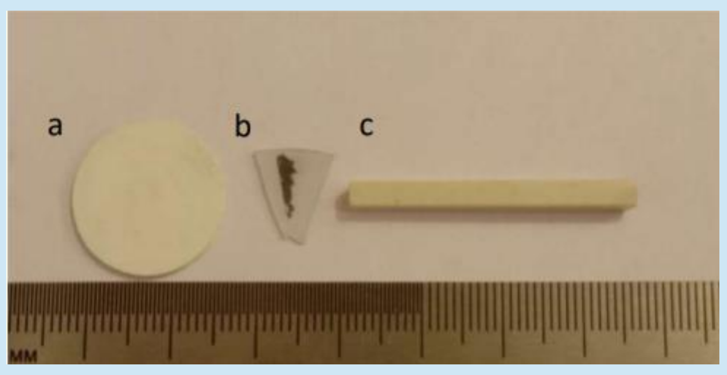

Figure 2. Samples of investigation:
a - functional environment for volumetric chemo-electronic converter – tablet;
b - Single crystal ZrO_2 with juvenile surface; **c** - Polycrystalline ZrO_2 with polished surface.

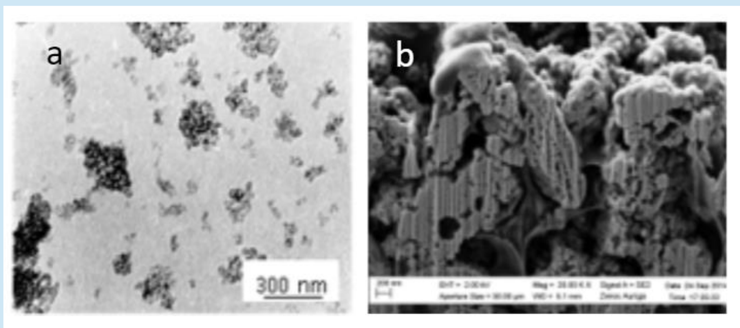

Figure 3. a - Transmission electron microscopy (TEM) images of nano-powder composition ZrO_2-3mol%Y_2O_3, 400ºC. 2Hours; **b** - Image scanning electron microscopy. Cross section of the film sample [4].

It is known that surface roughness can make the interpretation of RBS spectra difficult [3].
In our study, to solve the problem of studying the influence of irregularities on the spectrum display, some samples were analyzed.

- functional environment for planar chemo-electronic converter,

- functional environment for volumetric chemo-electronic converter – tablet polished/ unpolished.

For comparison, the spectra were also considered:

- **Polycrystalline ZrO_2 with polished surface;**
- **Single crystal ZrO_2 with juvenile surface.**

A functional layer for producing planar chemoelectronic converters in the form of rounded drops containing monodisperse nanosized (7.5 μm) particles of a solid solution of the ZrO_2 system -3 mol% Y_2O_3 (YSZ) in the PVA polymer matrix [4].
For the production of nanopowders used in chemical technology co-deposition with the use of physical effects [5].

Results

RBS is one of the most commonly used tools for depth pro- filing in various fields of physics, therefore the development of such a method is essential.
Figure 4a shows the results of RBS analysis of samples - functional environment for planar chemo-electronic converter and Figure 4b volumetric chemo-electronic converter – tablet polished/ unpolished.

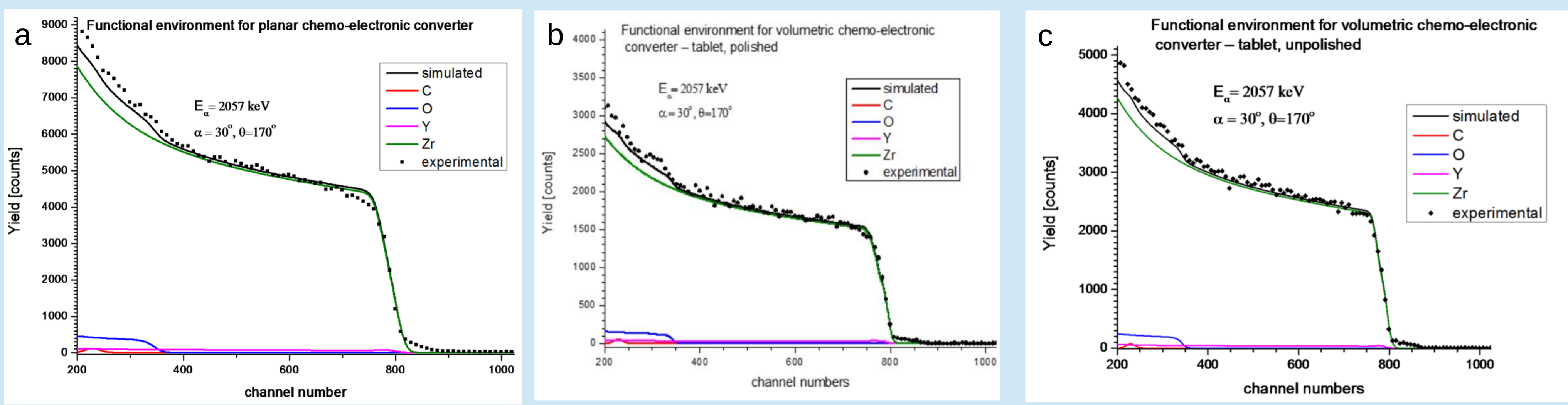

Figure 4. a - RBS spectrum of functional environment for planar chemo-electronic converter; **b** - RBS spectrum of volumetric chemo-electronic converter – tablet polished; **c** - RBS spectrum of volumetric chemo-electronic converter – tablet unpolished.

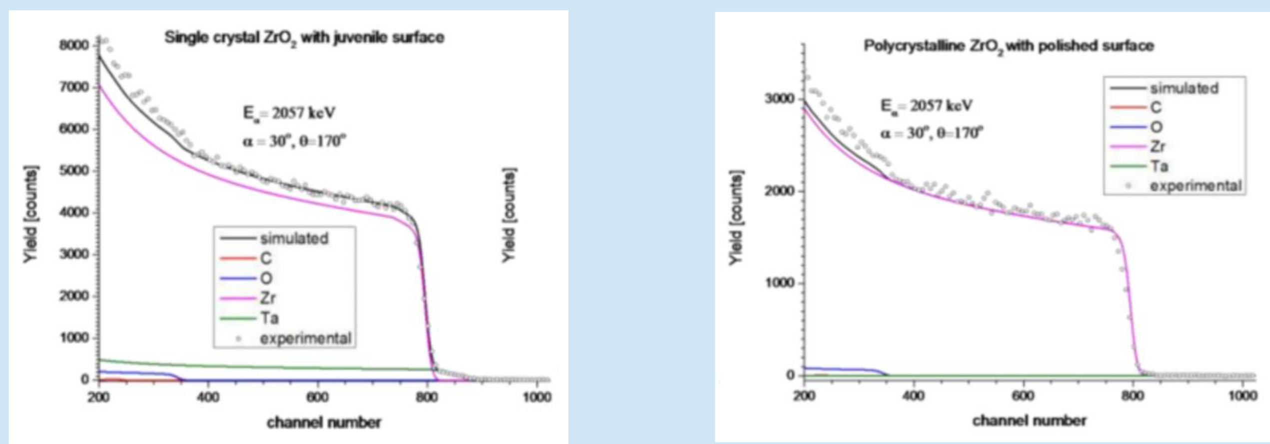

Figure 5. RBS spectrum of samples of the comparison.

Using the RBS technique, **depth profiles** of samples with **different surface types** were studied, and it was concluded that this method is **well suited** for **studying samples consisting of nanosized particles.**

Further study of the coating under research should have significant support for science and industry.

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