Influence of the ion fluences to transition layers in SiO_2/TiO_2 multilayer samples implanted Kr^+ ions.

P.L. Tuan[1,2,*], M. Kulik[2,3], T.V. Phuc [2,4,5], L.H. Khiem [4,5], Doroshkevich A.S.[2,6], A. Stanculescu[7], J. Żuk [3],

[1] Hanoi Irradiation Center, Vietnam Atomic Energy Institute, Hanoi, Vietnam

[2] Joint Institute for Nuclear Research, Dubna 141980, Russia

[3] Institute of Physics, Maria Curie-Skłodowska University, Pl. Marii Curie-Skłodowskiej 1, 20-031 Lublin, Poland

[4] Institute of Physics, Vietnam Academy of Science and Technology,10 Dao Tan, Ba Dinh, Hanoi, Vietnam

[5] Graduate University for Science and Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam

[6] Donetsk Institute for Physics and Engineering named after O.O. Galkin, 03028, Nauki ave., 46 Kiev, Ukraine

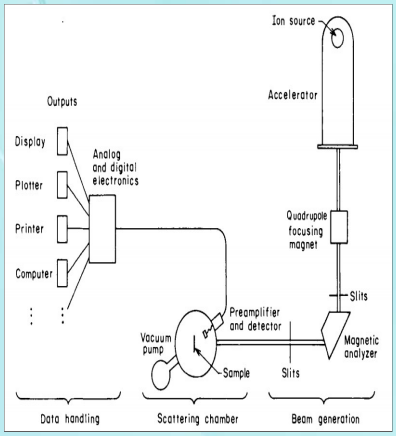
[7] National Institute for Materials Physics (NIMP) Strada Atomiştilor 405, Măgurele 077125, Romania.

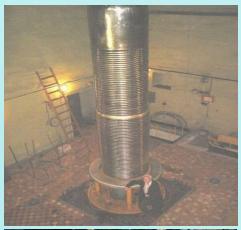
INTRODUCTION

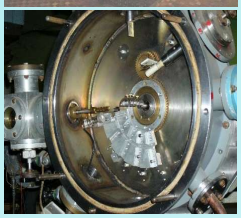
- Multilayers SiO_2/TiO_2 with Si substrate irradiated with 250 keV Kr^+ beam at room temperature. The implantation doses for individual sample varied from 1×10^{15} cm^{-2} to 3×10^{16} cm^{-2}.
- The thickness of these layers in the samples before and after ion irradiation were investigated by Rutherford backscattering spectrometry (RBS) method.
- The spectroscopy ellisometric (SE) method, the angle Ψ and Δ were determined.
- The SE and MAIE method were used in the study of pseudo dielectric function <ε> of the samples.

EXPERIMENTAL

- The multilayers SiO_2/TiO_2 samples were implanted with Kr^+ ions. The process was performed at room temperature with the use of a UNIMAS implanter.
- The thickness of these layers in the samples were investigated by RBS at FLNP, JINR, Dubna.

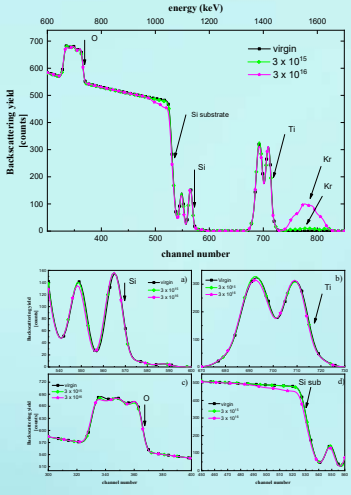






- The SE measurement were performed using the rotating-analyzer ellisometry (RAE) at room temperature. The spectra of the angles ψ(λ) and Δ(λ) were collected with the wavelength from 250 to 1000 nm and incident angles from 68^0 to 86^0. The optical parameter were calculated by using the Multiple-Angle-of-Incident Ellisometry (MAIE) method.
- The SE experiments were conducted at the Institute of Electron Technology, Lotników, Warsaw, Poland.

RESULTS AND DISCUSSIONS

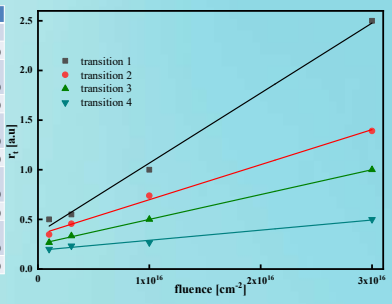


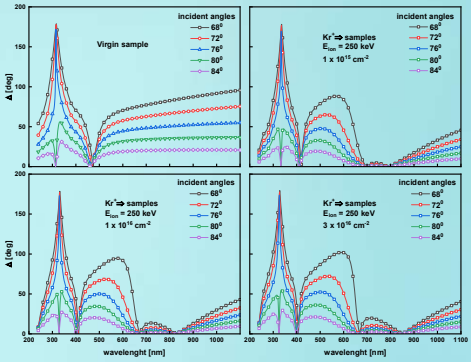
The spectra of scattered α particles on the nucleons of the atom located in the layers in virgin and implanted samples with Kr^+ ions.
All samples were measurements under the same conditions.

The shifting of these spectra in the regions of SiO_2, TiO_2 and Si substrate observed. These shifting increase when the fluence of ion increase.
This effect can be attributed to mixing of the atoms between SiO_2 and TiO_2 layers and the change of the concentration of displaced atoms in Kr+ implanted samples.

The forming and changing of thickness of layers in the samples were calculated by SIMNRA and the relative of there change were investigated.

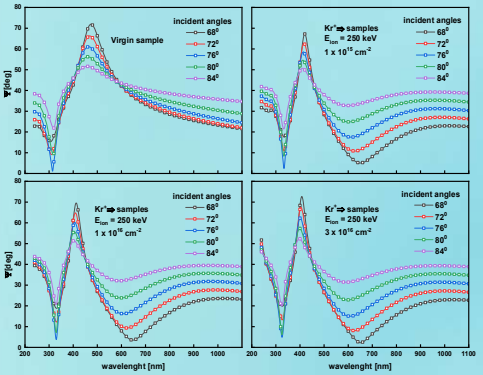
Layers	thickness (10^{15} at./cm²) virgin	1×10^{15}	3×10^{15}	1×10^{16}	3×10^{16}
SiO_2 (1)	104.0	95.0	95.0	89.0	63.0
transition 1	20.0	30.0	31.0	40.0	70.0
TiO_2 (2)	112.0	105.0	100.0	90.0	75.0
transition 2	23.0	31.0	33.5	40.0	55.0
SiO_2 (3)	90.0	80.0	74.0	73.0	45.0
transition 3	30.0	38.0	40.0	45.0	60.0
TiO_2 (4)	120.0	100.0	100.0	100.0	105.0
transition 4	30.0	36.0	37.0	38.0	45.0
SiO_2 (5)	85.0	95.0	95.0	95.0	97.0





These changes in the shape of the spectra Δ (E) can be attributed the thickness of these layers in the samples after ion implantation with different ion fluence.

Changes in the shape of the spectra Ψ (E) can be explained by the increase in the surface layer disorder due to an increase in the concentration of various defects in the samples.



CONCLUSIONS

- The forming and growing of transition layers between the SiO_2 and TiO_2 materials has been observed.
- The thickness of these transition layers increases as function of implanted fluence.
- These phenomenon was confirmed by the RBS measurement and SE data.

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