2020 International Conference on "Physics and Mechanics of New Materials and Their Applications"

PHENMA 2020

Kitakyushu, Japan, March 26–29, 2021

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Kyushu Institute of Technology
Southern Federal University
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Abstracts & Schedule

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The success of the Russian-Taiwanese Symposium "Physics and Mechanics of New Materials and Their Applications", PMNM-2012 (Russia, 2012), 2013 International Symposium "Physics and Mechanics of New Materials and Underwater Applications", PHENMA-2013 (Taiwan, 2013), 2014 International Symposium "Physics and Mechanics of New Materials and Underwater Applications", PHENMA-2014 (Thailand, 2014), 2015 International Conference "Physics and Mechanics of New Materials and Their Applications", PHENMA-2015 (Russia, 2015), 2016 International Conference "Physics and Mechanics of New Materials and Their Applications", PHENMA-2016 (Indonesia, 2016), 2017 International Conference "Physics and Mechanics of New Materials and Their Applications", PHENMA-2017 (India, 2017), 2018 International Conference "Physics and Mechanics of New Materials and Their Applications", PHENMA-2018 (South Korea, 2018) and 2019 International Conference "Physics and Mechanics of New Materials and Their Applications", PHENMA-2019 (Vietnam, 2019) predefined objectives and scientific directions of the new conference PHENMA-2020, conducted by the Kyushu Institute of Technology (Japan). Due to COVID-19 pandemic, this conference has been postponed from 2–5 October, 2020 to 26–29 March, 2021.

The following PHENMA abstracts cover five scientific directions: (i) processing techniques of new materials, (ii) physics of new materials, (iii) mechanics of new materials, (iv) applications of new materials, and (v) industry and management. These are present by scientists from 17 countries, demonstrating strong scientific collaboration, formed for last years.

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Optical Properties of $Sr_{0.61}Ba_{0.39}Nb_2O_6$ (SBN-61) Films Depending on Their Thickness

S.V. Kara-Murza[1]*, K.M. Zhidel[2], N.V. Korchikova[1], Yu.V. Tekhtelev[1], A.V. Pavlenko[3] A.G. Silcheva[1]

[1]*Lugansk Taras Shevchenko State University, Lugansk, Ukraine*
[2]*Research Institute of Physics, Southern Federal University, Rostov-on-Don, Russia*
[3]*Federal Research Center The Southern Scientific Centre of the Russian Academy of Sciences, Rostov-on-Don, Russia*

*skaramurza@gmail.com

The properties of the films of $Sr_{0.61}Ba_{0.39}Nb_2O_6$ (SBN-61) composition were studied by spectrophotometry and ellipsometry methods. The films were deposited by HF cathode atomization in oxygen atmosphere on single-crystal substrates of MgO with orientation (001). The time of deposition was 5 min, 10 min, and 115 min. The transmission spectra were measured in the wavelength range of 300–800 nm using a Shimadzu UV-50 spectrophotometer. In order to determine the thickness of the films and to perform a detailed study of their surface, ellipsometric measurements were performed using a multi-angle reflective ellipsometer at a wavelength of 632.8 nm helium-neon laser. To determine the optical parameters of the films, we used a two-layer model of the surface, including a base transparent layer with a thickness d_0 with a refractive index n and a disturbed layer with effective parameters d_{ef} and n_{ef}. The effective refractive index of the surface of the damaged layer was recalculated into the coefficient of volumetric filling with the material of the damaged layer. Spectral measurements of optical transmittance made it possible to find the dispersion of the refractive index of an ordinary ray n_o, which for all studied films is consistent with the data presented in the literature for crystals. Ellipsometry data show that the measurement results are independent of the plane of incidence of the probe beam. These results are confirmed by X-ray diffraction analysis, according to which all films are heteroepitaxially grown, and the natural growth direction of [001] coincides with the direction of the *c*-axis of the SBN-61 structure. In addition, it was found that the parameter *c* of the films is somewhat larger compared to a single crystal, and it increases with decreasing film thickness. It should be noted that the accuracy of ellipsometric measurements does not make it possible to reliably determine the influence of the parameter *c* and, therefore, the contribution of anisotropy to the results. Nevertheless, the results of ellipsometric measurements of films of various thicknesses are of interest from the viewpoint of the formation of a surface disturbed layer. Table 1 shows the results obtained by ellipsometry for all three SBN-61 films.

Table 1

Sputtering time, *t*, min	Film thickness, d_0, nm	Refractive index, *n*	Disturbed layer		Volumetric factor of filling out
			d_{ef}, nm	n_{ef}	
5	29	2.3	5	1.65	0.6
10	47	2.3	5	1.65	0.6
115	623	2.31	8	1.47	0.45

A decrease in the refractive index of the thin films is associated possibly with an increase in the anisotropy parameter *c* and its influence on an increase in the unit cell volume; it leads to a decrease in the refractive index *n*. Of particular interest in the results obtained is the large thickness of the disturbed layer in the thickest film, which is due, in our opinion, to the peculiarity of their growth (Volmer-Weber mechanism).

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Investigation of the Dependence of the Velocity of SAW Propagation under FeNi Films, Located on Lithium Niobate Substrates, on Magnetic Field

G.Ya. Karapetyan[1]*, V.E. Kaydashev[2], M.E. Kutepov[1], T.A. Minasyan[1], V.A. Kalinin[3], V.O. Kislitsyn[3], E.M. Kaidashev[1]

[1]*Laboratory of Nanomaterials, Southern Federal University,*
200/1, Stachki, 344090 Rostov-on-Don, Russi.
[2]*Moscow Institute of Physics and Technology,*
9, Institutskiy per., Dolgoprudny, 141701, Russia
[3]*LLC STC "RUS", 199178, Saint-Petersburg, Maly Ave., V. I. 54, Built 5, Russia*

*jorichkaka@yandex.ru

The propagation of surface acoustic waves (SAWs) under the thin-film piezo-magnetic structure of FeNi/ZnO/$LiNbO_3$ was studied. FeNi magnetostrictive films were obtained by pulsed laser deposition with a ZnO sublayer on the surface of lithium niobate. The deposition was carried out from a target of the FeNi alloy with a percentage of iron and Nickel of 2:1, the thickness of The FeNi film was equal to 500 nm, and the ZnO sublayer was 250 nm. The length of the film was 4 mm. A special setup was also developed to measure the effect of magnetic on the SAW propagation velocity (Fig. 1).

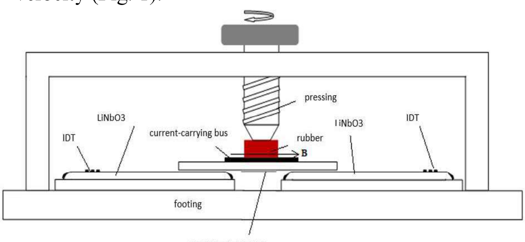

Fig. 1

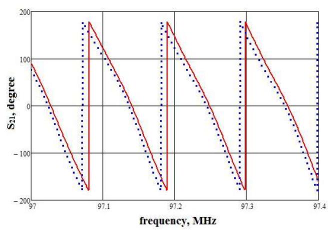

Fig. 2

This setup allowed measuring the SAW velocity in *YX*/128° lithium niobate substrates, which were coated with a FeNi film. This substrate was pressed against two substrates located on the both side