Seminar

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Institute for Plasma Research

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Title: Tuning the structural and optical properties of (K, Na)NbO_3 thin films using different approaches

Speaker: Dr. Radhe Shyam

Malaviya National Institute of Technology, Jaipur

Date: 12th October 2023 (Thursday)

Time: 10:30 AM

Venue: Online

Google meet link: https://meet.google.com/avs-jwdq-hxb

Abstract

In recent years, technological innovation in environment-friendly multifunctional materials has become a thrust area in research. In this regard, (K, Na)NbO_3 (KNN) qualifies to be a promising candidate amid diverse lead-free families due to the remarkable piezoelectric response along with high Curie temperature (~400°C)[1,2]. My Ph.D. thesis mainly describes the tailoring of structural, morphological, chemical state, and optical properties of RF-sputtered KNN thin films by different post-treatment methods, which include swift heavy ion (SHI) irradiation (100 MeV Ni, 100 MeV Ag, 120 MeV Au ion beams), low-energy ion implantation (30 keV Li-ion), and annealing processes such as rapid thermal annealing (RTA) and conventional furnace annealing (CFA). The in-depth analysis of structural, morphological, optical, and luminescent properties of KNN films and the possible origin of photoluminescence were reported.

A systematic modification in the various properties of KNN films is observed after 120 MeV Au ion irradiation. An interesting finding from this study is that films show the crystalline-to-crystalline phase transition (KNN exhibits superior properties at morphotropic phase boundary) at lower ion fluence and crystalline-to-amorphous phase upon irradiation at higher fluences[3]. Li-ion implantation of KNN thin films shows a minor variation in transmittance and band gap; however, the crystallinity is reduced gradually with ion fluence. PL intensity and the probability of radiative transition are found to be increased with ion fluence[4]. Moreover, the comparative study of RTA and CFA results reveals that the crystallinity and grain size are higher in CFA samples. However, the band tails extended more with annealing temperatures in CFA samples. PL intensity and transition via radiative states are more for samples annealed using RTA[5]. The obtained results demonstrate the possible use of KNN for optoelectronic applications.

References

[1] Y. Saito, H. Takao, T. Tani, T. Nonoyama, K. Takatori, T. Homma, T. Nagaya, and M. Nakamura, Nature **432**, 84 (2004).

[2] X. Lv, J. Zhu, D. Xiao, X. Zhang, and J. Wu, Chem. Soc. Rev. **49**, 671 (2020).

[3] R. Shyam, D. Negi, K. Shekhawat, F. Singh, S. Ojha, G.R. Umapathy, P. Vashishtha, G. Gupta, S. Pandey, P. Dobbidi, and S.R. Nelamarri, Phys. Status Solidi **220**, 2300179 (2023).

[4] R. Shyam, D. Negi, K. Shekhawat, F. Singh, D. Devi, P. Vashishtha, G. Gupta, S. Pandey, P. Dobbidi, and S. Rao Nelamarri, Results Phys. **47**, 106330 (2023).

[5] R. Shyam, D. Negi, K. Shekhawat, M. Kumar, M. Gupta, P. Vashishtha, G. Gupta, A. Das, P. Dobbidi, and S.R. Nelamarri, Phys. B Condens. Matter **660**, 414908 (2023).