**Niobium Doping Effect on ZnO Nanorods**

***Hakan ÇOLAK1,2\****

*1ScienceFaculty, Chemistry Department, Çankırı Karatekin University, Çankırı, Türkiye*

*2* *Central Research Laboratory (ÇANKAM), Çankırı Karatekin University, Çankırı, Türkiye*

|  |
| --- |
|  **Abstract**Niobium metal doped ZnO nanorods were synthesized on a glass substrate by ultrasonic spray pyrolysis technique in two steps. The structural, morphological, and optical properties of the produced samples were investigated via x-ray diffractometer (XRD), a field emission scanning electron microscopy (FE-SEM) combined with energy dispersive x-ray spectroscopy (EDX), and an ultraviolet/visible spectrophotometer (UV/VIS). The XRD patterns were indexed in the hexagonal (wurtzite) unit cell for all the ZnO samples. Also, according to the XRD peaks it was understood that the crystals grow in the c-axis (002) direction. The morphological characteristics of the obtained thin films were analyzed by. From the SEM micrographs, it was observed that ZnO thin films doped with Nb had a nanorod structure in the c-axis direction. The presence of Nb ions in the samples was confirmed via EDX analysis. The optical transmittances of the samples were measured at a wavelength of 300-1000 nm. It was observed that the produced films had high optical transparency. The average optical transmittance value of the samples is 90 %. |
| Keywords: Zinc oxide, Nanorod structure, Doping process, Ultrasonic spray pyrolysis system. |

**Acknowledgment**

This research was financially supported by Çankırı Karatekin University Scientific Research Projects Coordinatorship (ÇAKÜ BAP), Project No. FF031114B05.

**References**

1. Pearton, S.J., Norton, D.P., Ip, K., Heo, Y.W., & Steiner, T. (2003). Recent progress in processing and properties of ZnO. *Superlattices and Microstructures*, 34 (1-2), 3-32.
2. Grzanka, E., Gierlotka, S., Stelmakh, S., Palos, B., Strachowski, T., Sroda, A.S., Kalisz, G., Lojkowski, W., & Porsch, F. (2006). Phase transition in nanocrystalline ZnO. *Zeitschrift für Kristallographie Supplements*, 23, 337-342.
3. Sirelkhatim, A., Mahmud, S., Seeni, A., Kaus, N.H.M., Ann, L.C., Bakhori, S.K.M., Hasan, H., & Mohamad, D. (2015). Review on zinc oxide nanoparticles: antibacterial activity and toxicity mechanism. *Nano-Micro Letters*, 7(3), 219–242.
4. Lee, J.B., Le, H.J., Seo, S.H., & Park, J.S. (2001). Characterization of undoped and Cu-doped ZnO films for surface Acoustic wave applications. *Thin Solid Films*, 398-399, 641-646.
5. Bagnall, D., Chen, Y., Zhu, Z., Yao, T., Koyama, S., Shen, M., & Goto, T., (1997). Optically pumped lasing of ZnO at room temperature. *Applied Physics Letters*, 70 (17), 2230-2232.
6. Tang, Z., Wong, G., Yu, P., Kawasaki, M., Ohtomo, A., Koinmura, H., & Segawa, Y. (1998). Room-temperature ultraviolet laser emission from self-assembled ZnO microcrystallite thin films. *Applied Physics Letters*, 72 (25), 3270-3272.
7. Lee, W., Kang, J., & Chang K. (2006). Electronic structure of phosphorus in ZnO. *Physica B: Condensed Matter*, 376-377, 699-702.
8. Çolak, H., & Karaköse, E. (2017). Green synthesis and characterization of nanostructured ZnO thin films using Citrus aurantifolia (lemon) peel extract by spin coating method. *Journal of Alloys and Compounds*, 690, 658-662.
9. Sangeetha, G., Rajeshwari, S., & Venckatesh, R. (2011). Green synthesis of zinc oxide nanoparticles by Aloe barbadensis miller leaf extract: structure and optical properties. *Materials Research Bulletin*, 46 (12), 2560-2566.