**Low-resistivity of highly nitrogen-doped p-type Cu2O thin films prepared by reactive HiPIMS**

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One of today's challenging scientific topics is finding a suitable p-type TCO that would at least approach the optoelectronic properties of the n-type counterpart [1]. Finding such p-type material is a necessary condition for the further sustainable technological development of society. The realization of p-n junctions using transparent conductive materials will enable the development of a new generation of invisible electronics, contribute to reducing the energy requirements of various optoelectronic devices or lead to the production of more efficient solar cells. Transparent conductive materials based on Cu2O appear to be among the most promising. This is mainly due to the abundance of elements used, their non-toxicity and interesting optoelectronic properties. One of the limiting factors in Cu₂O layers is the low mobility of free holes. In our previous work [2], we demonstrated that post-deposition laser annealing can effectively enhance hole mobility.

In our work, we systematically investigated the role of nitrogen incorporated in Cu2O thin films, mainly on optical and electrical properties, namely optical band gap and electrical resistivity. The Cu2O:N films were prepared by reactive HiPIMS of Cu circular target (100 mm in diameter) in Ar+O2+N2 atmosphere. The pulse-averaged target power density (*Sda*) was varied from ≈ 100-1300 Wcm-2, and the fraction of N2 in (Ar+N2) mass flow was 0–90 %. A decreasing trend for resistivity has been seen with the increasing amount of nitrogen. The prepared p-type Cu2O:N films with the highest value of a nitrogen fraction of 90% exhibited very low resistivity about $5×10^{-2} Ωcm$ exceeding current state of the art.

[1] J. Singh, P. Bhardwaj, R. Kumar, V. Verma, Progress in Developing Highly Efficient p-type TCOs for Transparent Electronics: A Comprehensive Review, J Electron Mater (2024). https://doi.org/10.1007/s11664-024-11445-7.

[2] J. Rezek, M. Kučera, T. Kozák, R. Čerstvý, A. Franc, P. Baroch, Enhancement of hole mobility in high-rate reactively sputtered Cu2O thin films induced by laser thermal annealing, Applied Surface Science, (2024). https://doi.org/10.1016/j.apsusc.2024.160255.