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Local epitaxial growth of p-type TCO thin films at room temperature

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Copper and nickel oxides are well-known p-type transparent conductive oxides that can be used in various devices such as solar cells, TFT, electrochromic. The efficiency of such devices is strongly driven by the preferred orientation of the layers and by the structural quality of the interfaces. This communication aims to present an original way to control the texture of copper and nickel oxides that is independent of the deposition conditions.
Oxide thin films have been deposited at room temperature on glass and silicon substrates using a reactive magnetron sputtering process. Depending on the oxygen flow rate introduced into the deposition chamber, it is possible to selectively grow Cu_2O or Cu_4O_3 films. For both materials, the texture of the films is mainly governed by the deposition pressure. Then, a two-step deposition procedure is detailed to tune the film texture independently of the deposition conditions. We have demonstrated that the texture of the top layer is determined by that of the bottom layer. The bottom layer acts as a seed layer for the growth of the top one. Transmission electron microscopy analyses in cross-section show the top layer is epitaxially grown on the columns of the seed layer, indicating the existence of local homoepitaxial growth. The same kind of results has been obtained for NiO thin films. Furthermore, we have shown that the texture of NiO can be tuned using a seed layer of Cu_2O. Using this original procedure, it is possible to grow sputtered NiO films with a [111] preferred orientation that cannot be obtained by depositing directly NiO films on silicon substrate. Finally, the consequences of the new local epitaxial growth mechanism on the synthesis of self-assembled vertically aligned columnar oxide nanocomposite thin films on unmatched substrates is presented.

Keywords
p-type TCO
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