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Electromechanical performance of nano-architectured piezoresistive Ti1-xCux thin films for sensor applications

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This work reports on the development of piezoresistive $Ti_{1-x}Cu_x$ thin films for different types of sensors. Conventional (normal incidence) and zigzag grown columnar thin films were prepared with increasing amounts of Cu and then characterized in terms of the most relevant properties for some targeted sensing applications (including pressure, temperature and biological sensors, among others). For the zigzag growing films, the GLancing Angle Deposition, GLAD, technique was used to change the typical normal columnar growth microstructure into different growing architectures, aiming the tuning of the mechanical and electrical responses of the thin films in order to scan their potential use in the sensing applications. Two different incident angles of the particle flux, α= 0º and 45º, were used to prepare the nano-architectured zigzag $Ti_{1-x}Cu_x$ thin films. For the conventional grown films (normal incidence deposition, α= 0º), the obtained results show that larger voids were formed, which began to elongate, resulting in relatively well-defined void tracks. By using the GLAD 45º incidence growth, the voids density started to decrease with the increase of the Cu content, resulting in quite promising films for the targeted applications. The piezoresistive response was then analyzed for different GLAD sputtered films, through the evaluation of the Gauge Factor (GF). The results show that the structure has a pronounced influence on the overall sensor response leading to values of the GF up to 1.8 for the system $Ti_{1-x}Cu_x$ and reaches values of 16 for Cu thin films which stability has to be studied for potential use for sensor applications itself.

Keywords
Piezoresistive
Gauge Factor
GLAD
Thin Films
Titanium