Nanocomposites and nanomaterials

Formation of vanadium oxide films with a high resistance temperature coefficient by oxygen ion implantation

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The vanadium oxide film is a promising material for uncooled low-noise microbolometers, since the sensitive element of the device must be a film with a high resistance temperature coefficient (TCR). For VO_X films this is achieved due to the semiconductor-to-metal phase transition (SMT). Since the vanadium oxide exists in multiple phases therefore SMT temperatures are different for each phase: V_2O_3 (~ -113°C), VO_2 (~68°C), V_2O_5 (≥256°C). Only vanadium dioxide has the SMT in the room temperature range. So, presence the sufficient amount of VO_2 crystallites in the VO_X film is necessary for high IR-sensitivity. As a rule, VO_X films contain a mixture of VO, V_2O_3, VO_2, V_2O_5 phases. It leads to the electric shunting or isolation of VO_2 crystallites. That restricts the TCR value and leads to increased noise. DC magnetron sputtering is the most commercially attractive method for the VO_X film creation. In our previous work the method of low temperature deposition (250–300°C) with following low temperature annealing (300°C) was proposed for the high-ordered VO_2 phase formation and VO_X film synthesis with a high TCR value (~7%/K) [1]. For successful implementation of this method, before annealing stage it is important to have an amorphous VO_X ($1.8<x<2.2$) film with rare inclusions of VO_2 and V_2O_3 crystallites. To obtaine the required functional properties of the film the low-temperature annealing mode (depends on X value), that provides a controlled growth of certain vanadium oxide phases can be used. Obtaining of VO_X film with a certain X value is a complex task because this parameter is very sensitive to the slightest changes of the deposition conditions.

We propose to adjust the component composition of the deposited film by oxygen ion implantation for formation during annealing the high TCR value film.

1. *Goltvyanskyi Yu., Khatsevych I., Kuchuk A., Kladko V., et al.* Structural transformation and functional properties of vanadium oxidefilms after low-temperature annealing // Thin Solid Films.-2014.- **264**.-P. 179-185.