Overview on VO_x based Microbolometers

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Abstract:
Uncooled infrared (IR) detectors also known as Microbolometer with a large focal-plane array (FPA) have been developed with surface micromachining technology. Among the materials applied for semiconductors based microbolometers, Vanadium Oxides (VO_x) has been explored due to its unique characteristics of high temperature coefficient of resistance (TCR) at room temperature and relatively low noise.

Vanadium Oxide has multi oxidation states and distinctive crystalline arrangement which results in different phases for instance, VO_2, V_2O_5 and V_2O_3.These phases undergo transition from an insulator or semiconductor to a metal phase at a specific temperature. Single-crystal VO_2 and V_2O_5 have proven to have large TCR of above -4%/^oC. However, the deposition of VO_2 thin film is tedious and requires a high-cost ion beam method. V_2O_5 phase can be easily fabricated with high O_2 partial pressure, but it is reported to have high resistance at room temperature. Moreover, V_2O_3 due to its low formation energy tends to have transition from semiconductor to metal phase at -123 ^{o}C hence its resistance is very low at room temperature. Thus, for the deposition of VO_x thin films to have high TCR and low resistance, it is necessary to form a suitable mixed phase of VO_2, V_2O_5 (for high TCR) and V_2O_3 (for low resistance).

Moreover, one of the important aspect in improving performance and efficiency of microbolometer is to have wider range of temperature and should remain constant preferably at room temperature for compatibility with ROIC. One way to achieve is modulating phase transition characteristics of VO_x thin films which would widen the temperature range for operation as well as reduce hysteresis width between cooling and heating cycles

With this motivation, the primary focus of this talk would involve in-depth analyses on various factors affecting growth and performance of VO_x thin films for optimization of thermal sensitive layer to gain understanding on TCR and MIT dependence for microbolometer device structure.