High-performance Infrared-sensing Vanadium Oxide Thin Films

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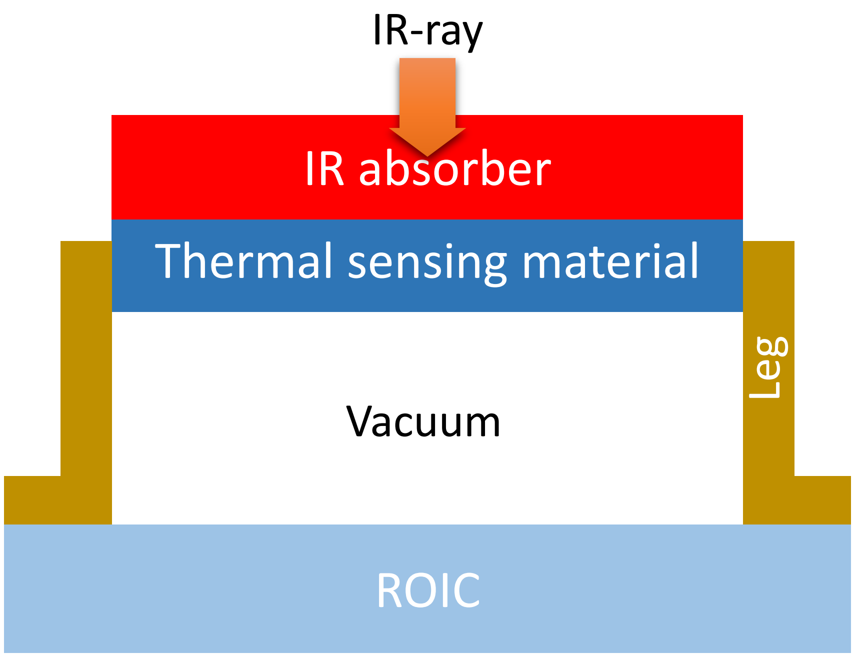
Uncooled Microbolometer



Working principle

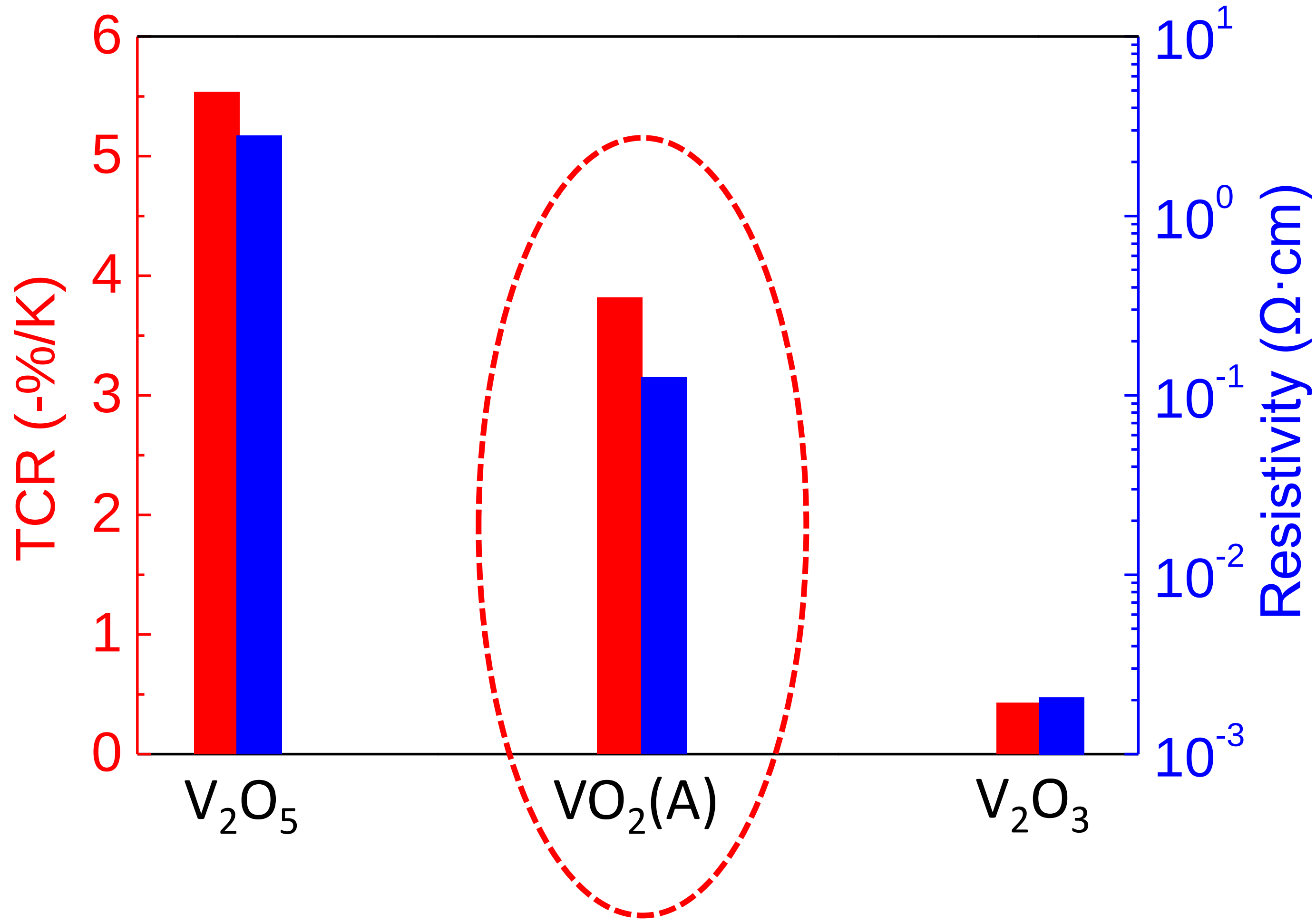
1. Absorption of IR-ray
2. Increase of temperature
3. Change of resistance

Requirement of thermal sensing material

Material's Properties	Unit	Goal	Purpose
TCR	-%/K	> 3	- High sensitivity
Resistivity	Ω·cm	< 1	- High signal-to-noise ratio

Electrical properties of VO_x thin films

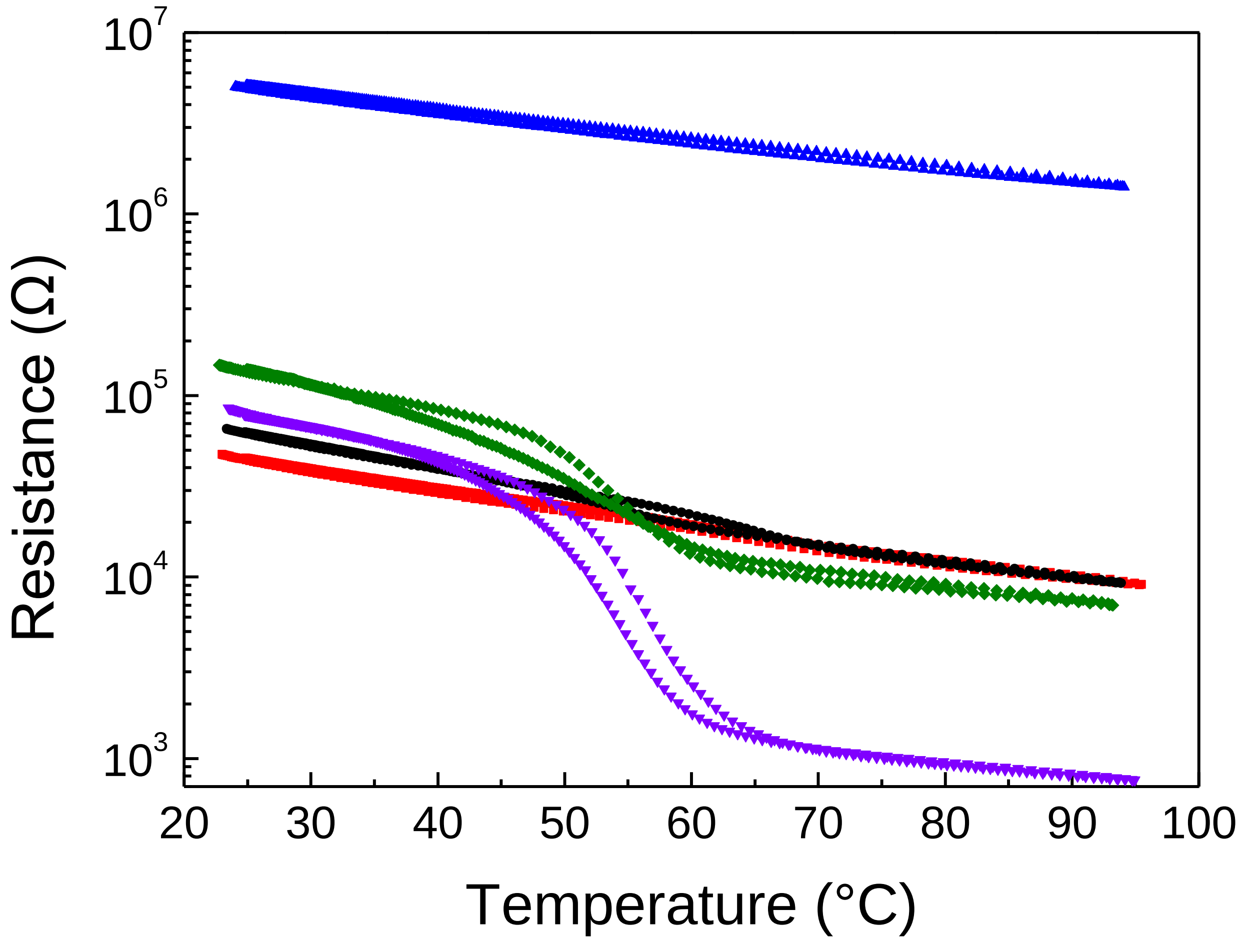
Polymorphic - VO, V_2O_3, VO_2(A), VO_2(M), VO_2(B), V_3O_7, V_4O_9, V_6O_{13}, V_2O_5 ……



VO_2(A): low resistivity, high TCR

Non-reproducible !

1 success out of 5 runs

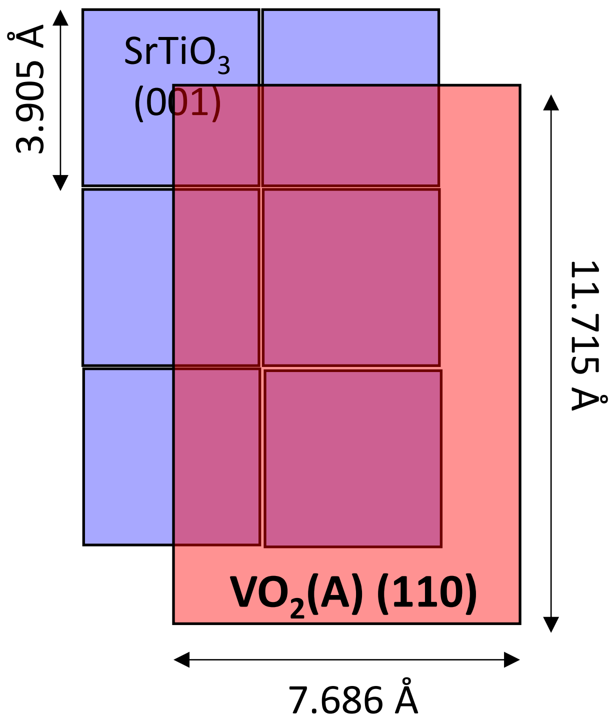


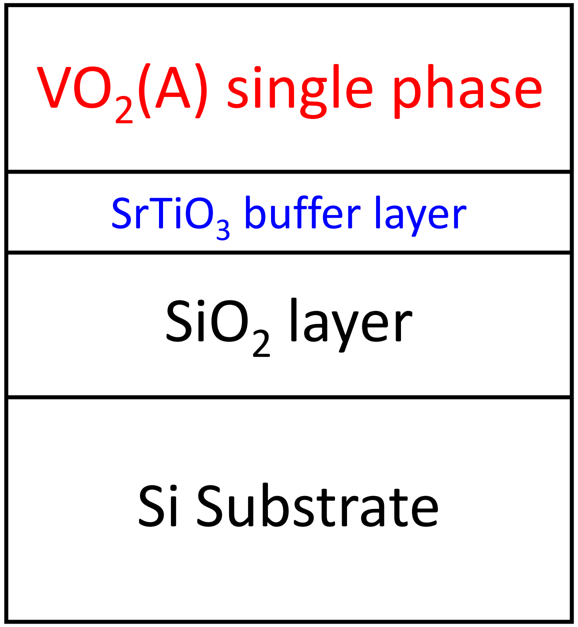
Phase stabilization by buffer layers

- Similar crystal structure

- Single phase

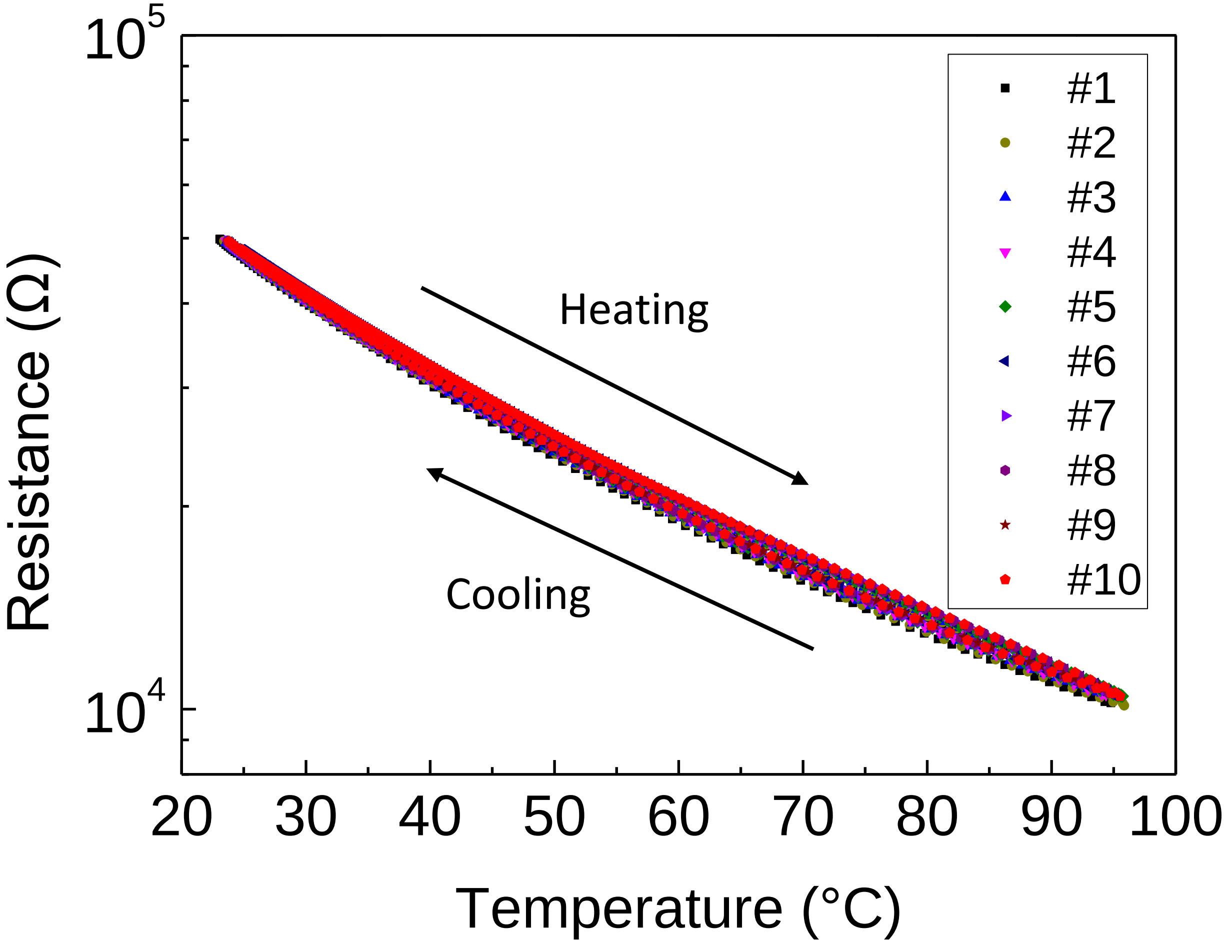
- Insulator





Both reproducible and reliable

20 successes out of 20 runs



Results of our experiments

1. High TCR: -3.40 %/K (>-3%/K)

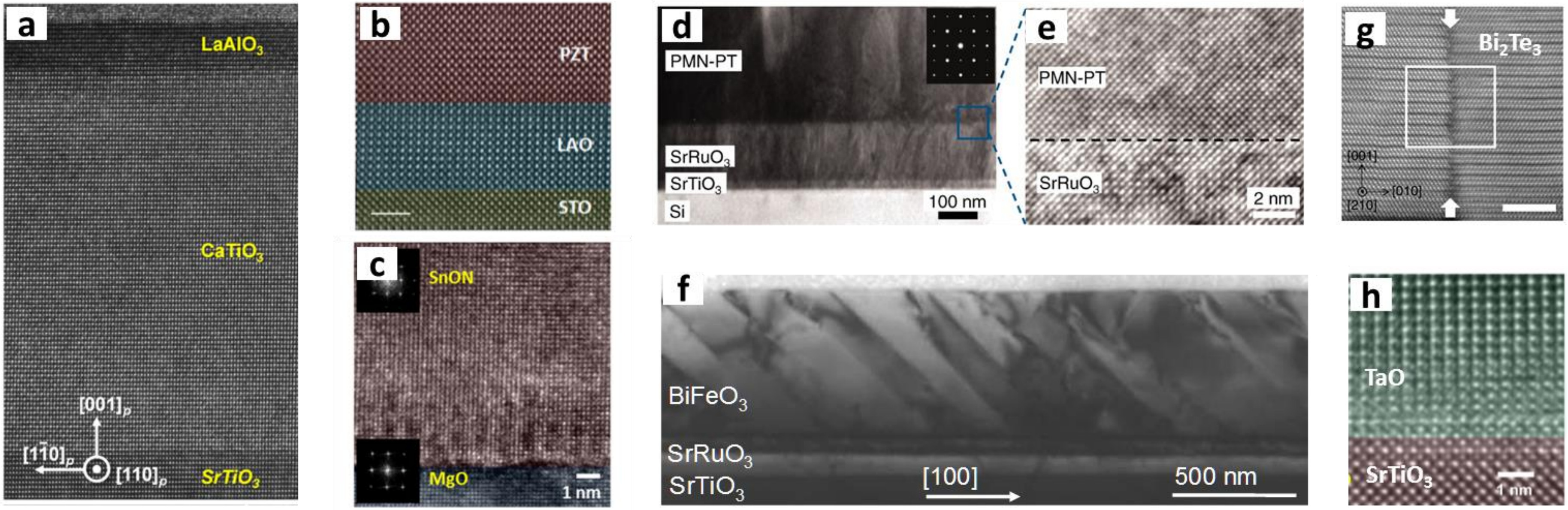
2. Low resistance: ~0.05 Ω·cm (<1 Ω·cm)

3. Temperature stability: to 95 °C (>80 °C)

4. Low temperature process: 300 ℃ (<350 °C)

5. Reproducibility: very high

Epitaxial oxide thin films



$LaAlO_3$, $CaTiO_3$, $SrTiO_3$, PZT, La(Sr,Mn)O_3, $SrRuO_3$, PMN-PT, CuO, In_2O_3, NiO, Ta_2O_5, Bi_2Te_3, SnON, etc.

- Thermoelectric materials and devices
- Energy harvesting
- Piezoelectric MEMS
- Interfacial phenomena at oxide interfaces

Thank You