

Semiconductor Sensors:

Ch6: Gas Sensors cont.

Metal Oxide Resistive Gas Sensor

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اکسیدهای فلزی به عنوان حسگر حسگر گاز

حسگر اکسید فلزی از نوع مقاومتی مرسوم ترین حسگر گاز نیمه رسانا است.

Table 2.1 Metal oxides preferred for applications in various types of chemical sensors

Sensor type and (sensor elements)	Detected gas	Metal oxides preferred for application
Chemiresistor (semiconductor)	Reducing gases (CO, H ₂ , CH ₄)	SnO ₂ ; CTO; Ga ₂ O ₃ ; In ₂ O ₃
	Oxidizing gases (O ₃ , NO _x , Cl ₂)	In ₂ O ₃ ; WO ₃ ; ZnO; TiO ₂
	H ₂ S; SO ₂	SnO ₂ /CuO; SnO ₂ /Ag ₂ O
	NH ₃	WO ₃ ; MoO ₃ ; In ₂ O ₃
	CO ₂	SnO ₂ /La ₂ O ₃ ; Al ₂ O ₃ /V ₂ O ₅ ; BaTiO ₃ /CuO; BaSnO ₃
	Alcohol	La ₂ O ₃ /In ₂ O ₃ ; La ₂ O ₃ /SnO ₂ ; In ₂ O ₃ /Fe ₂ O ₃
Oxygen	Ga ₂ O ₃ ; SrTiO ₃ ; SrTiFeO ₃ ; TiO ₂ ; Nb ₂ O ₅ ; ZnO	
Humidity	In ₂ O ₃ /SiO ₂ ; TiO ₂ /MgCr ₂ O ₄ ; SrTiO ₃ ; LaFeO ₃	
Electrochemical (solid electrolyte)	Oxygen	ZrO ₂ :Y; Bi ₂ O ₃ /MoO ₃ ; SrCeO ₃ ; SrTiO ₃ ; SrTiFeO ₃
	H ₂	Sb ₂ O ₃ ; BaCeO ₃ ; BaCeO ₃ :Gd; ZrO ₂ :Y; SrCeO ₃ ; SrCeO ₃ :Yb, In; SrZrO ₃ ; BaZrO ₃ ; CaZrO ₃

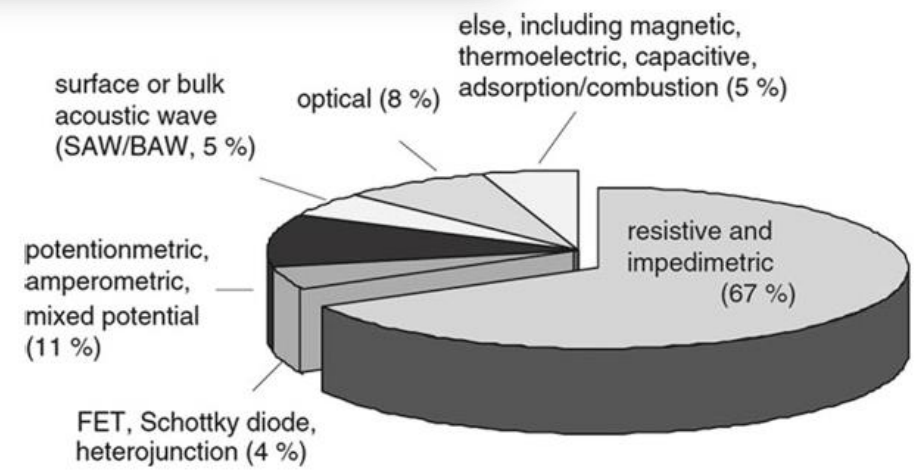
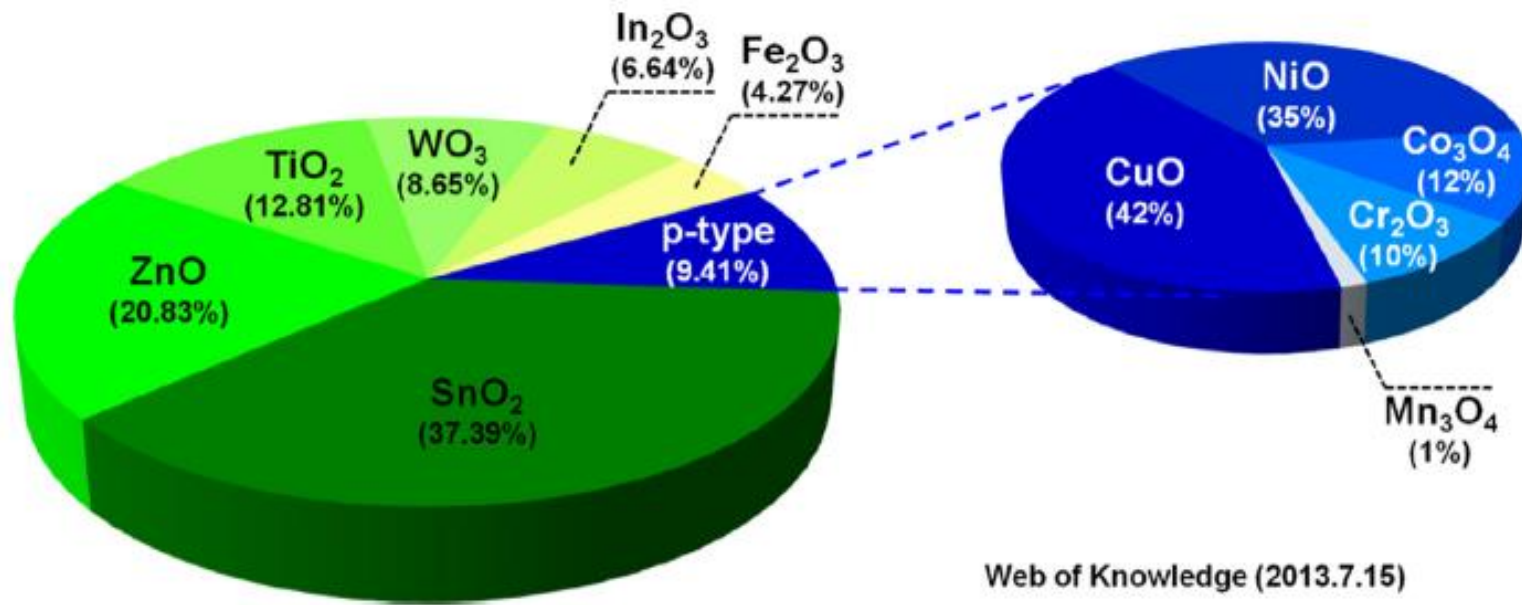


Fig. 2.1 Literature review: various types of metal oxide-based gas sensors discussed in 2007 (based on a total of 340 papers available via ISI Web of Science) (Reprinted with permission from Sahner and Tuller (2010). Copyright 2010 Springer)

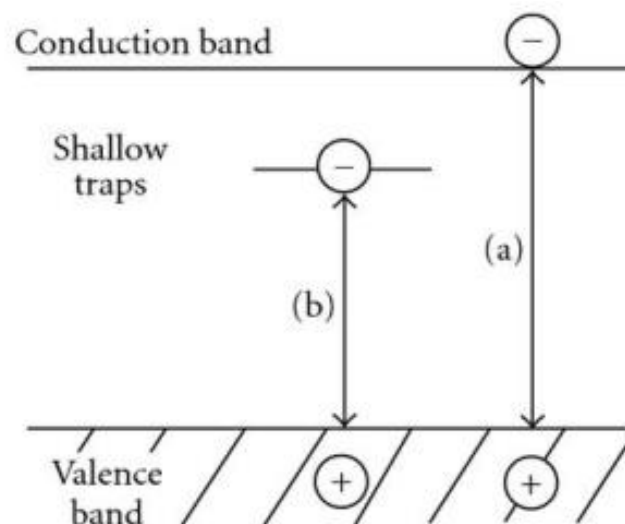
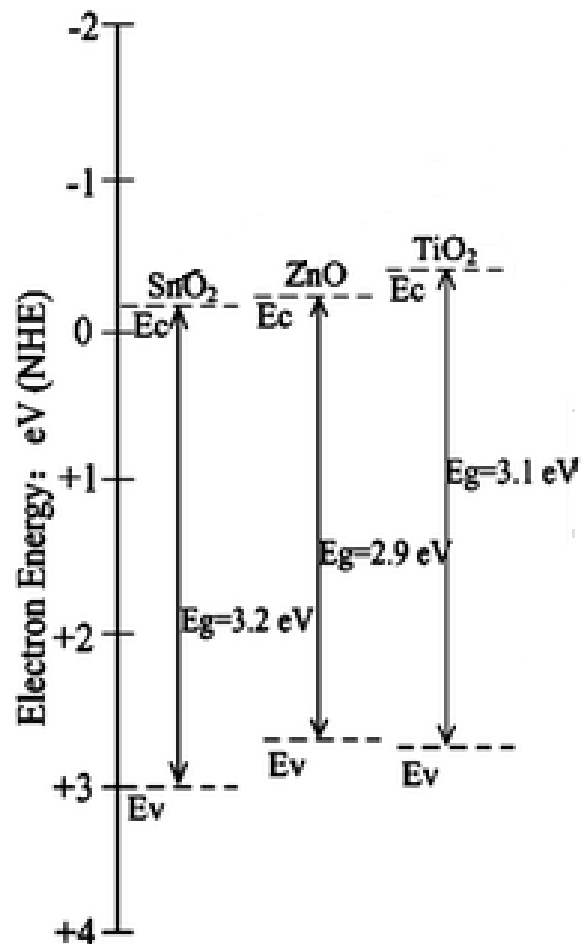
اکسیدهای فلزی به عنوان حسگر گاز

H.-J. Kim, J.-H. Lee / *Sensors and Actuators B* 192 (2014) 607–627



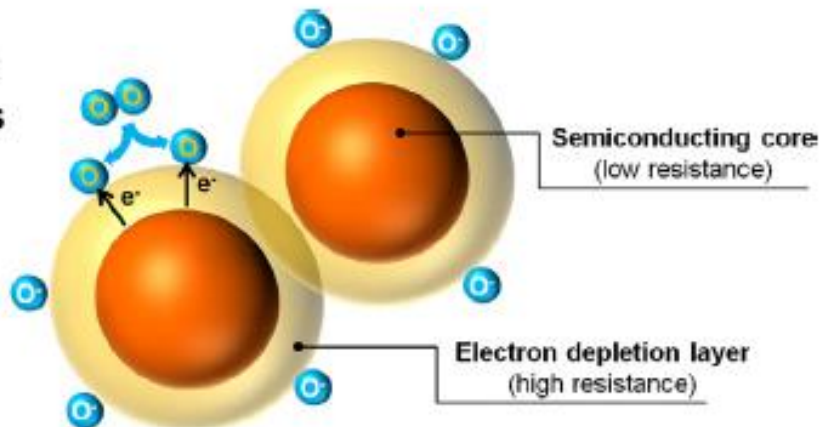
Studies on n- and p-type oxide semiconductor gas sensors (internet search of Web of Knowledge on July 15, 2013).

اکسیدهای فلزی نیمه رساناهای با پهنای باند بزرگ

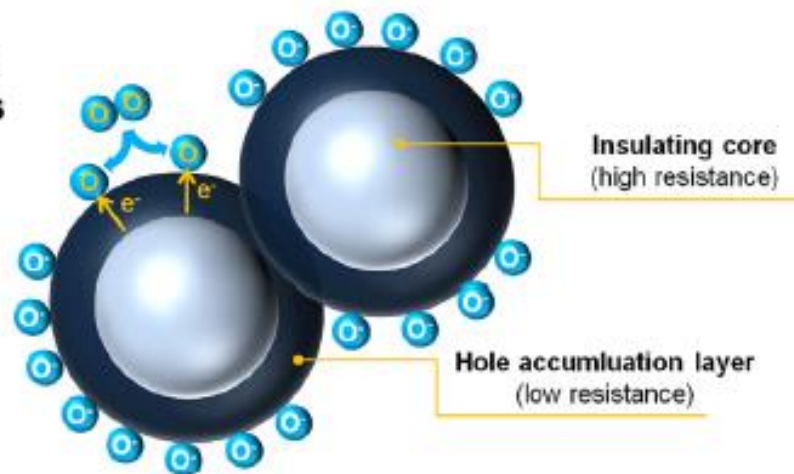


اثر جذب اکسیژن هوا به سطح دانه های بس بلورین نیمه رسانای اکسید فلزی P و N:

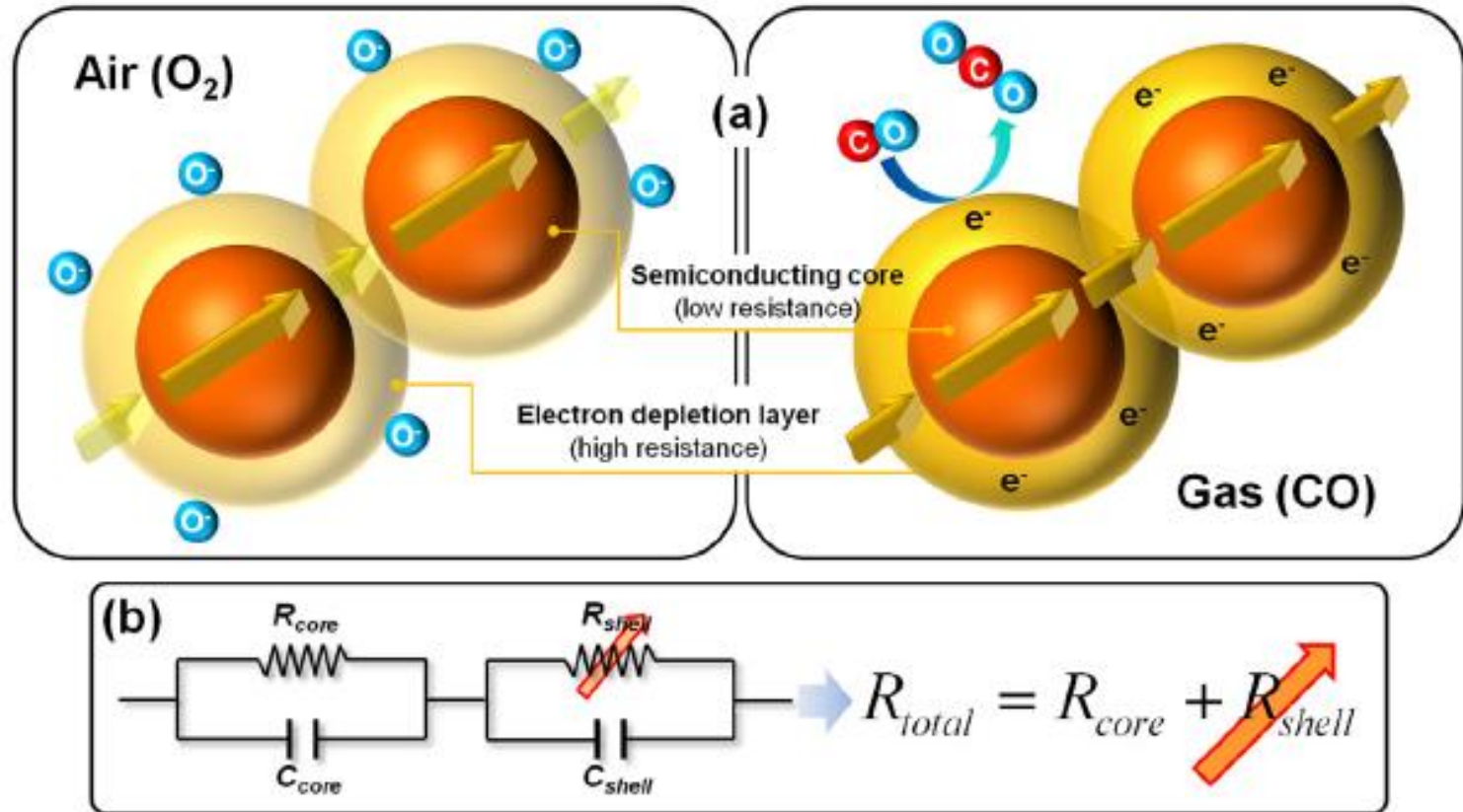
(a) n-type oxide semiconductors



(b) p-type oxide semiconductors



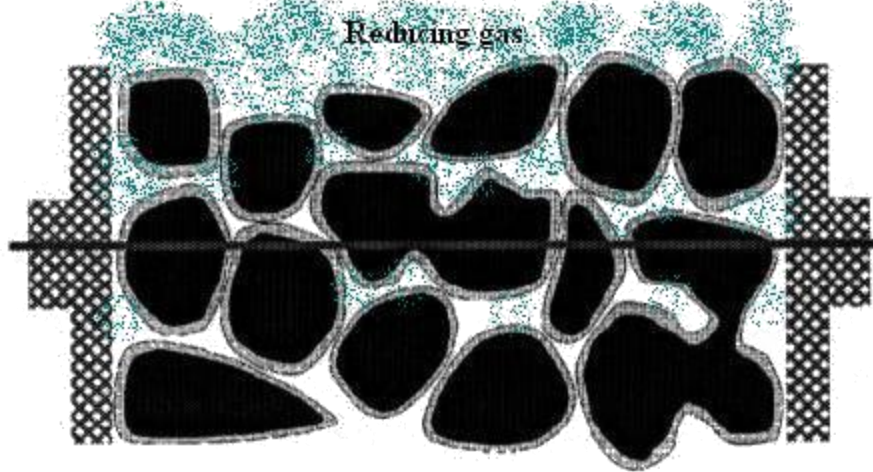
واکنش سطح ساختار بس بلوری اکسید فلزی نوع N به گاز



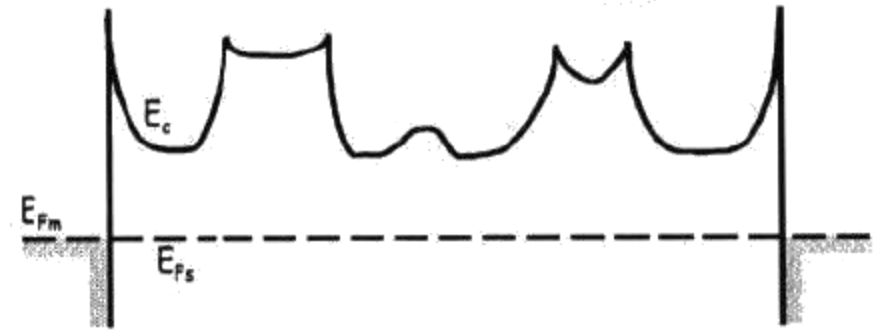
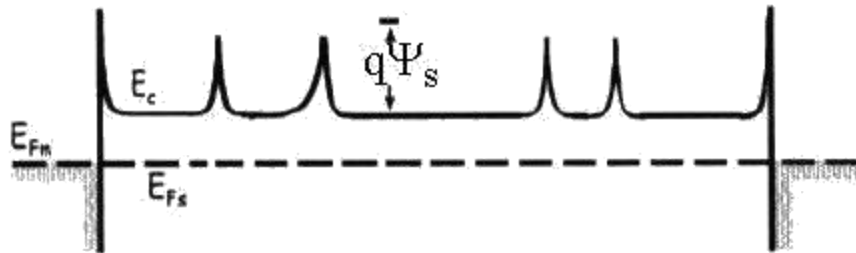
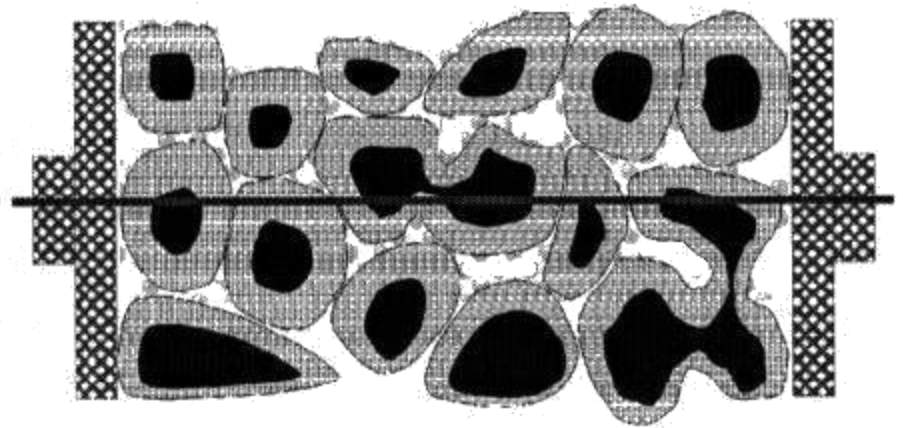
حسگر گاز مقاومتی با ساختار بس بلوری اکسید فلزی نوع N

- N-type polycrystalline metal-oxide resistive gas sensor surface interaction with surrounding gases.

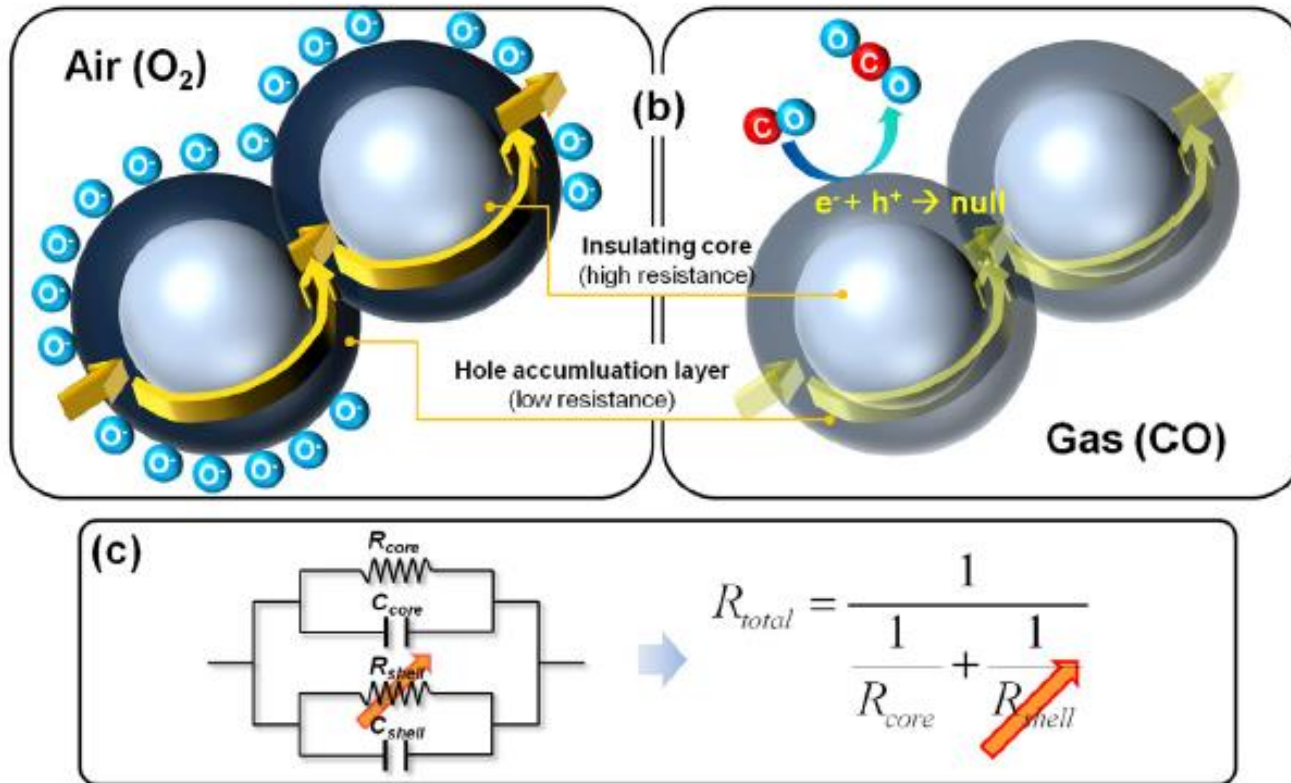
گاز احیایی (هیدروژن، منو اکسید کربن، الکل ها و ...)



اکسیژن هوا (گاز اکسیدی)



واکنش سطح ساختار بس بلوری اکسید فلزی نوع P به گاز



□ Ex: FIS SP3AQ2

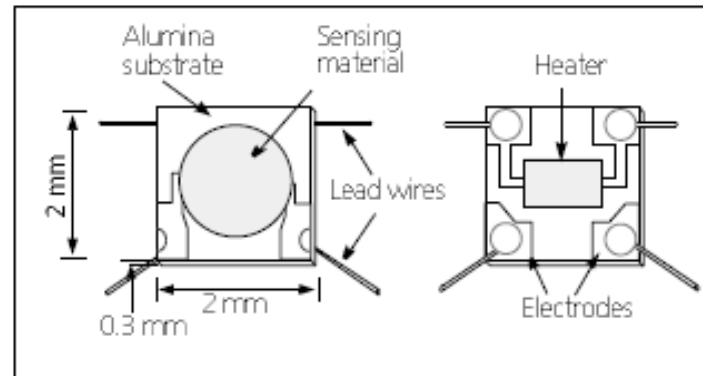


Fig 1a. Sensing element

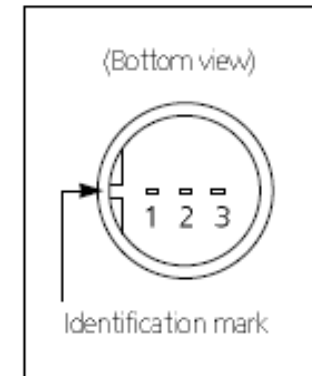


Fig 1c. Pin Layout

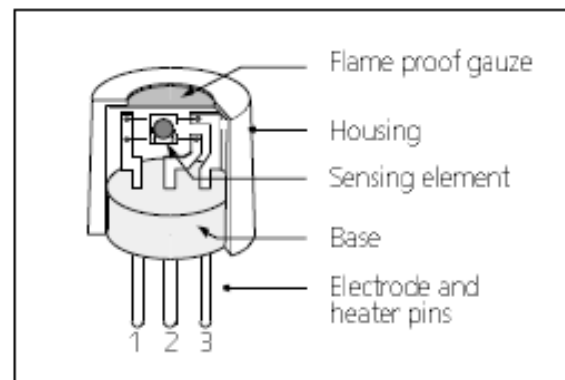
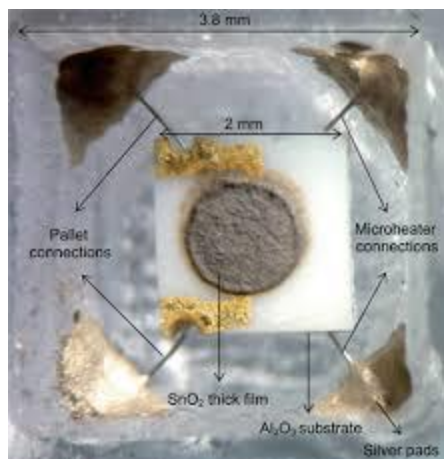


Fig 1b. Configuration

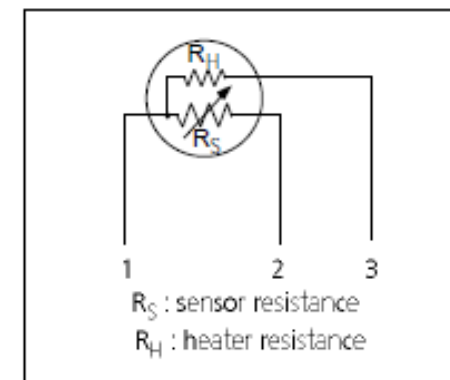


Fig 1d. Equivalent circuit