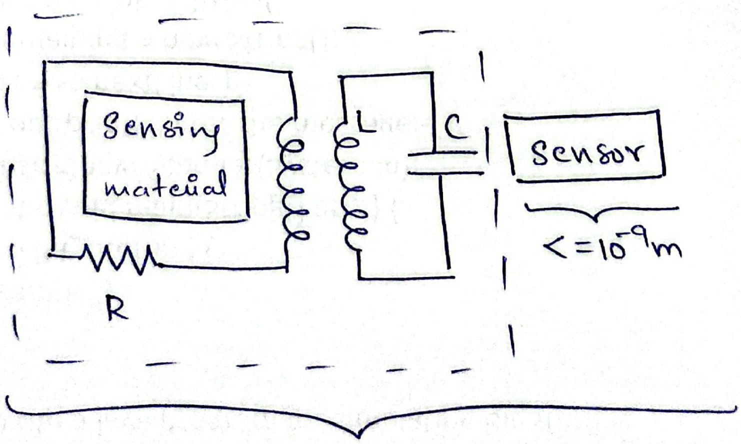
⇒ Nanosensors -

* due to unexpected breakthrough in nanotechnology field in the past decade, development of nanostructures in sensor field has increased.

* nanosensors are sensors capable of performing mechanical and electrical functions and are sized to nanometers, i.e., 10^{-9} m.

* 4 types - ① physical nanosensors
  ② chemical "
  ③ biological "
  ④ optical "

* some examples - ① carbon nanotubes and proximity probe
  ② lithographic scheming
  ③ implantation of nanocrystals
  ④ " of nano-biological sensors in non-biological environment
  ⑤ integration of nanoparticles in gas sensors
  ⑥ quantum effect
  ⑦ industrial appl. - * STM
  * AFM



working model

⇒ Wiedeman Effect -

* used to produce torque (or) / (and) force sensors.

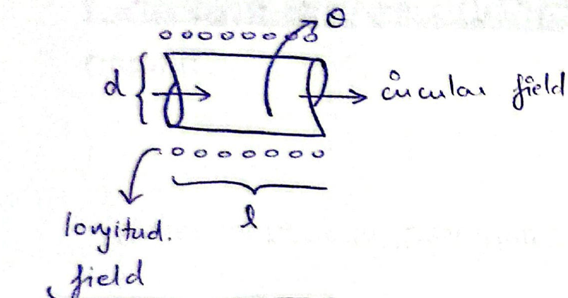
* wiedeman effect → twisting of a ferromagnetic rod when placed in a longitudinal magnetic field and current passing through it.

* formula,

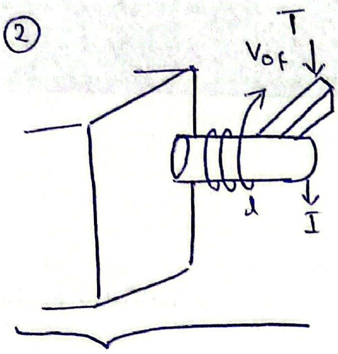
$$\theta = (\lambda_l - \lambda_t) \times \frac{4l}{d} \times \frac{H_l H_r}{H_l^2 + H_r^2}$$

where, θ → angle of rotation, l → length of rod, d → diameter of rod, H_l → longitudinal mag. field, H_r → circular mag. field, λ_l → longitudinal magnetostrictive constant, λ_t → translation magnetostrictive constant.

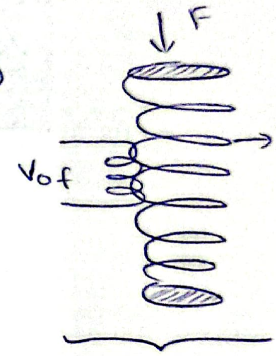
* diagrams -

① 

working

② 

torque sensor

③ 

force sensor

* two inverse effects of wiedeman effect -

① production of longitudinal field due to twisting of rod upon circular field.

② production of circular field due to previously produced longitudinal field.

⇒ film sensor -

* basically smart sensors
* produced by depositing films of different thicknen on appropriate substrates.
* have varying electrical and mechanical properties.
* types - ① thick film ② thin film.

Thick film -

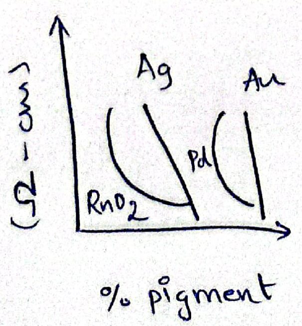
* used for producing resistors, capacitors and conductors.
* process - ① select and prepare the substrate
  ② prepare the coating material in paste / paint form
  ③ paste / paint the material on substrate
  ④ firing the sample produced in ③ in oxidising atmosphere at programmed temperature format.

* used substrates -

	dielectric constant	thermal expansion co-efficient	thermal conductivity
① Alumina	9.5	6.5×10^{-6}	0.36 W/cm
② Beryllia	7	7.5×10^{-6}	2.5 W/cm

* there should be no difference b/w thermal conductivities of substrate & the coated material which would cause stress and leads to zero offset, instability.

* applications - ① temperature sensing → thermopiles, thermistors (Au, Pt, Mn, Co)
  ② pressure " → $Al_2O_3 + Bi_2Ru_2O_7$
  ③ gas " → $SnO_2 + Pd$; hydrophobic $SiO_2 \cdot H_2$
  ④ humidity " → resistive film, capacitive film
  ⑤ industry → ceramic - metal with Au/Ag oxide.



} variation graph.

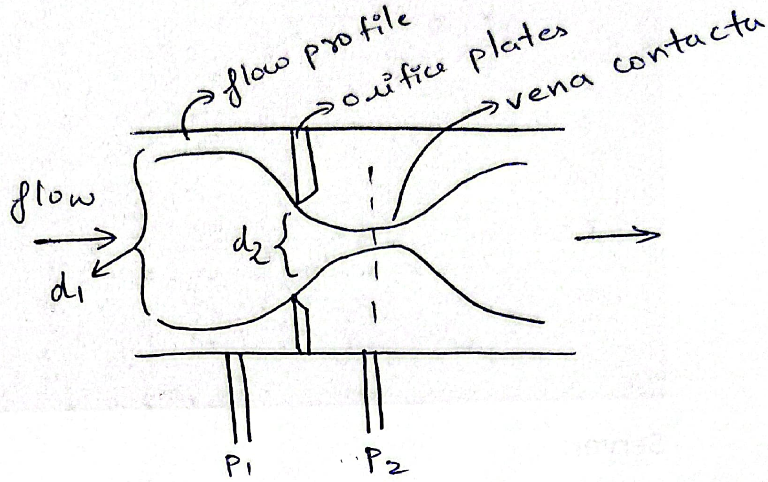
⇒ Venturimeter & Orifice meter -

* types of flowmeter for measuring flow rate of liquids.
* based on principle of "constant area variable pressure drop".
* depending on type of obstruction, they vary.

Orifice Meter -

* most common flowmeter
* orifice plate placed inside the pipeline itself
* flow rate, is pressure diff. $= P_1 - P_2$
* advantages -

  1. low cost
  2. easy to install
  3. simple construction



Venturi Meter -

* operates on Bernoulli's principle
* has 3 section - 1. converging inlet
  2. narrow throat
  3. diverging outlet

* flow rate, is difference between pressures at inlet and throat.
* disadvantages -

  1. high cost
  2. pressure loss
  3. complex design.