دانشگاه علم و صنعت ایران

تاسیس ۱۳۰۸

موجبرهای Strip line

مطالب مورد بحث

۱. قوانین گاوس، لاپلاس و پواسون
۲. قوانین ماکسول
۳. موجهای صفحه ای
۴. انواع موجبرها
   ۱. موجبرهای صفحات موازی
   ۲. موجبرهای مستطیلی
   ۳. انواع دیگر موجبرها
۵. استریپ لاین ها
۶. مزایا و معایب استریپ لاین ها

Gauss,Laplace and Poisson

Gauss → $\nabla \cdot \mathbf{D} = \rho_v$

Gradiant relation → $\mathbf{E} = -\nabla V$

→ $\nabla \cdot \nabla V = -\dfrac{\rho_v}{\epsilon}$ ***Poisson***

Free Charge Space → $\boxed{\nabla^2 V = 0}$ ***Laplace***

Laplace

$$\nabla^2 V = \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0 \qquad \text{(cartesian)}$$

$$\nabla^2 V = \frac{1}{\rho}\frac{\partial}{\partial \rho}\left(\rho \frac{\partial V}{\partial \rho}\right) + \frac{1}{\rho^2}\left(\frac{\partial^2 V}{\partial \phi^2}\right) + \frac{\partial^2 V}{\partial z^2} \qquad \text{(cylindrical)}$$

$$\nabla^2 V = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2 \frac{\partial V}{\partial r}\right) + \frac{1}{r^2 \sin\theta}\frac{\partial}{\partial \theta}\left(\sin\theta \frac{\partial V}{\partial \theta}\right) + \frac{1}{r^2 \sin^2\theta}\frac{\partial^2 V}{\partial \phi^2} \qquad \text{(spherical)}$$

Maxwell

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \cdot \mathbf{D} = \rho_v$$

$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\mathbf{B} = \mu \mathbf{H}$$

$$\mathbf{D} = \epsilon \mathbf{E}$$

Plane Wave

$$\nabla \times \nabla \times \mathbf{E_s} = \nabla(\nabla \cdot \mathbf{E_s}) - \nabla^2 \mathbf{E_s} = -j\omega\mu_0 \nabla \times \mathbf{H_s}$$
$$= \omega^2 \mu_0 \epsilon_0 \mathbf{E_s} = -\nabla^2 \mathbf{E_s}$$

since $\nabla \cdot \mathbf{E_s} = 0$. Thus

$$\nabla^2 \mathbf{E_s} = -k_0^2 \mathbf{E_s}$$

Wavenumber

$$k_0 = \omega \sqrt{\mu_0 \epsilon_0}$$

Epsilon

$$\epsilon = \epsilon' - j\epsilon''$$

$$jk = \alpha + j\beta$$

$$\alpha = \mathrm{Re}\{jk\} = \omega\sqrt{\frac{\mu\epsilon'}{2}}\left(\sqrt{1+\left(\frac{\epsilon''}{\epsilon'}\right)^2} - 1\right)^{1/2}$$

$$\beta = \mathrm{Im}\{jk\} = \omega\sqrt{\frac{\mu\epsilon'}{2}}\left(\sqrt{1+\left(\frac{\epsilon''}{\epsilon'}\right)^2} + 1\right)^{1/2}$$

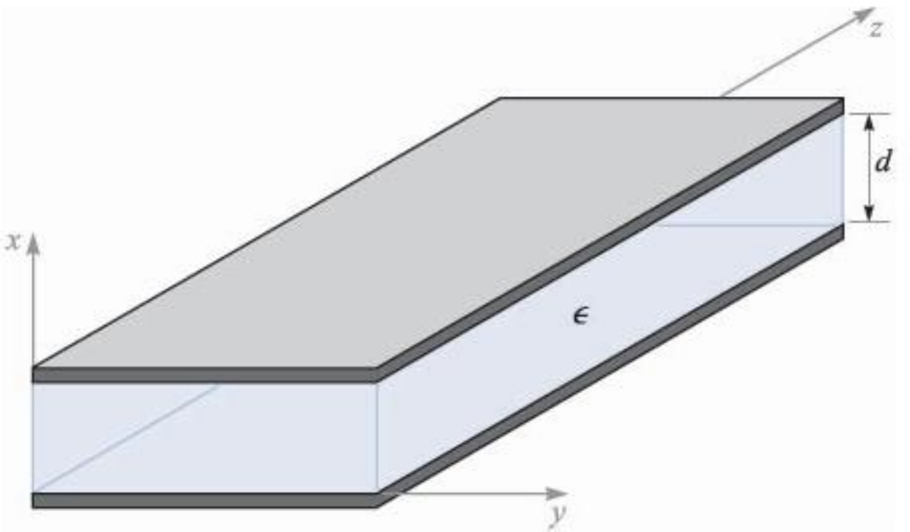
$$E_{xs} = E_{x0}e^{-jkz} = E_{x0}e^{-\alpha z}e^{-j\beta z}$$

حل معادله ی موج

- شرایط مرزی
- صفحه ی زمین
- جهت انتقال موج

Parallel Plate Waveguide

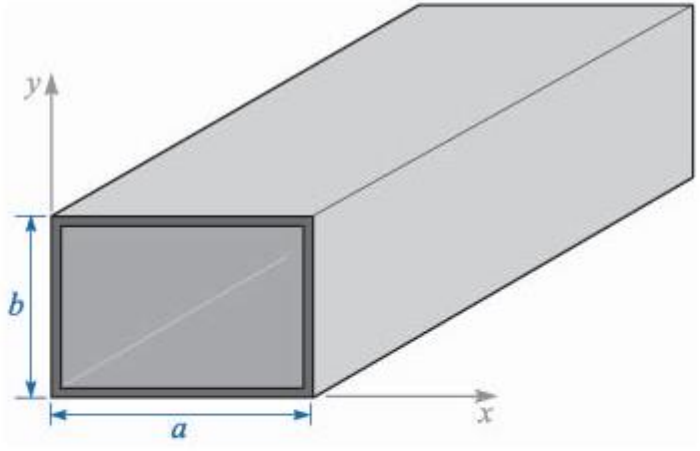
$$E_{ys} = E_0 \sin\left(\frac{m\pi x}{d}\right) e^{-j\beta_m z}$$



Rectangular Waveguide

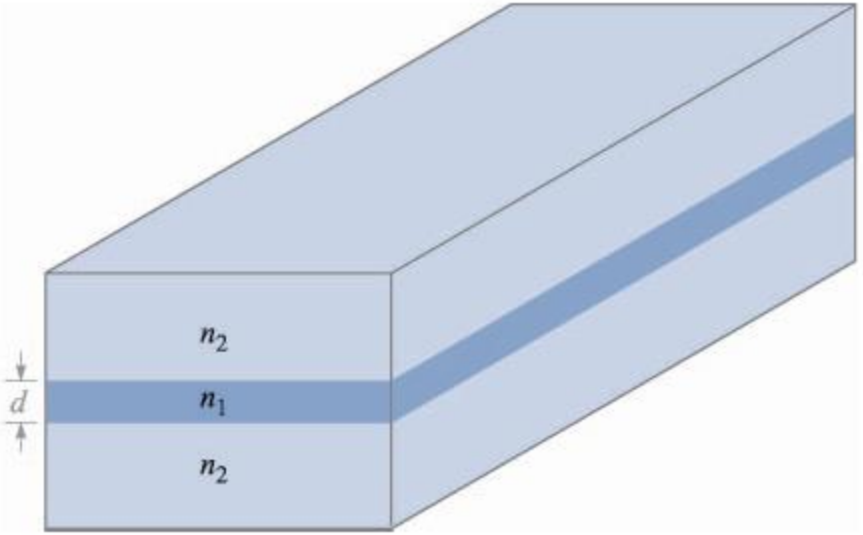
$$E_{ys} = E_0 \sin(\kappa_{m0} x) e^{-j\beta_{m0} z}$$

$$\omega_c(mp) = \sqrt{\left(\frac{m\pi c}{na}\right)^2 + \left(\frac{p\pi c}{nb}\right)^2}$$

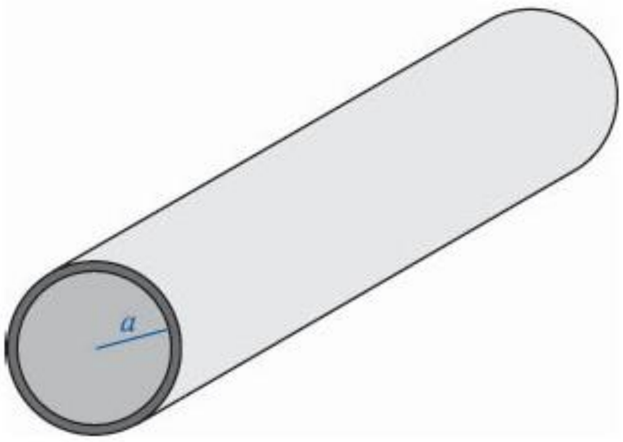


Other Types

Dielectric Slab Waveguide

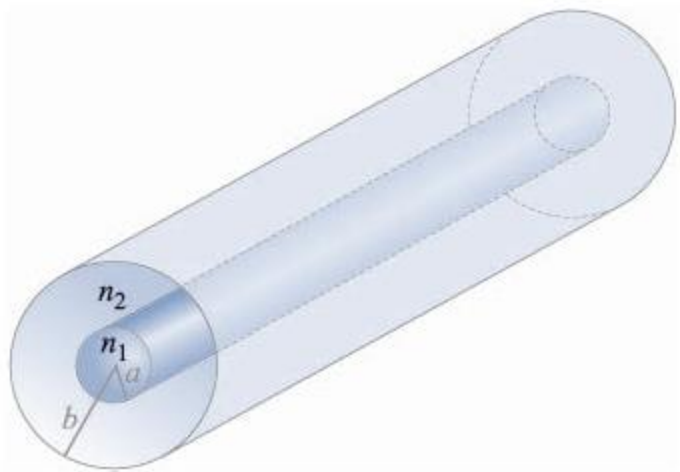


Cylindrical Waveguide

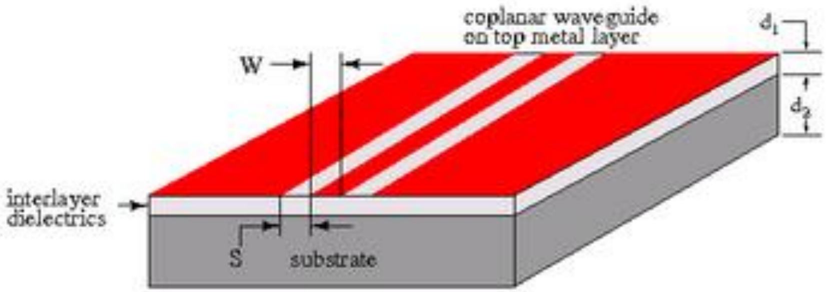


Other Types

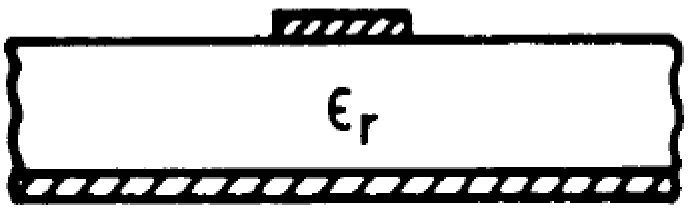
Optical Fiber Waveguide



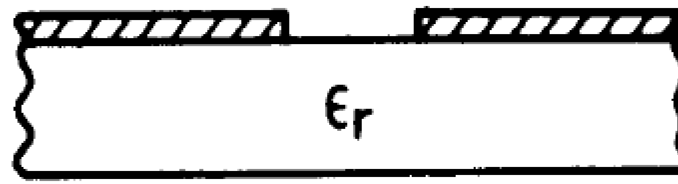
Strip Line Waveguide



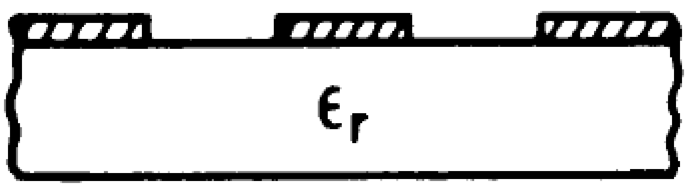
Strip Line



MICROSTRIP



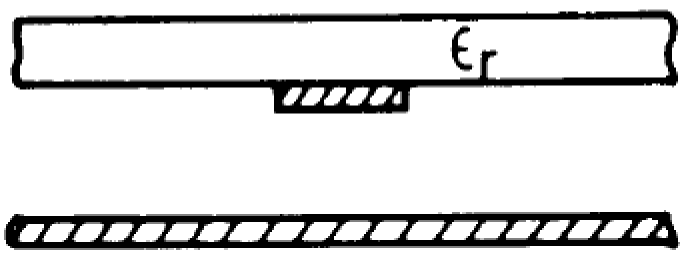
SLOTLINE



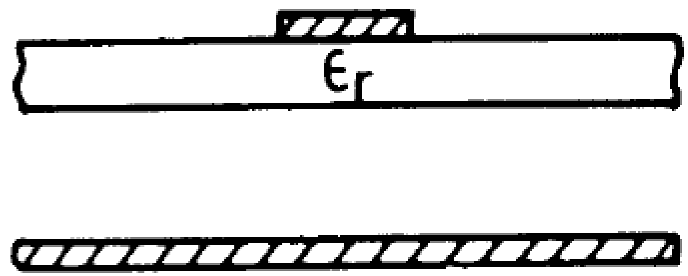
COPLANAR WAVEGUIDE

COPLANAR STRIPS

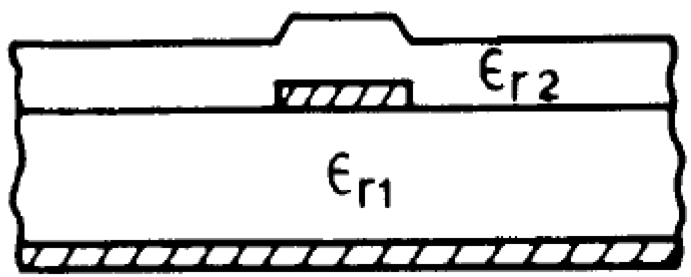
Strip Line



INVERTED MICROSTRIP

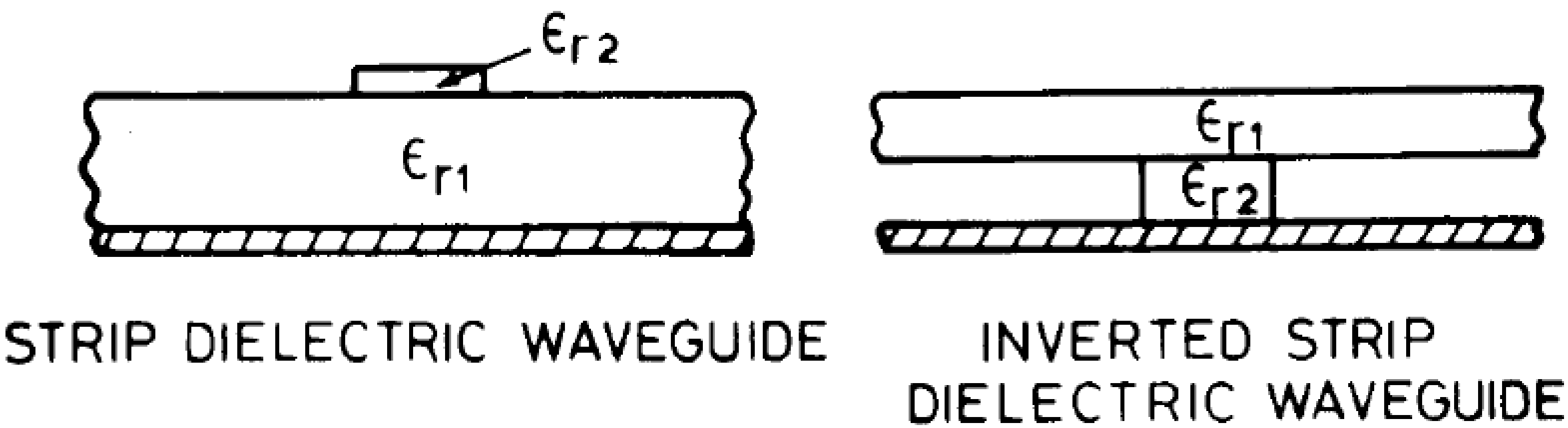


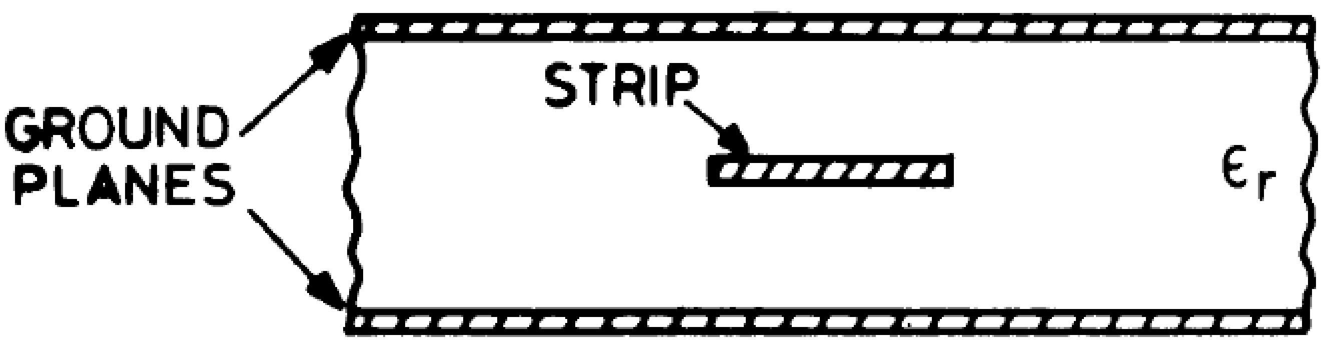
SUSPENDED MICROSTRIP



MICROSTRIP WITH OVERLAY

Strip Line





Strip Line Waveguide

Methods of Analysis

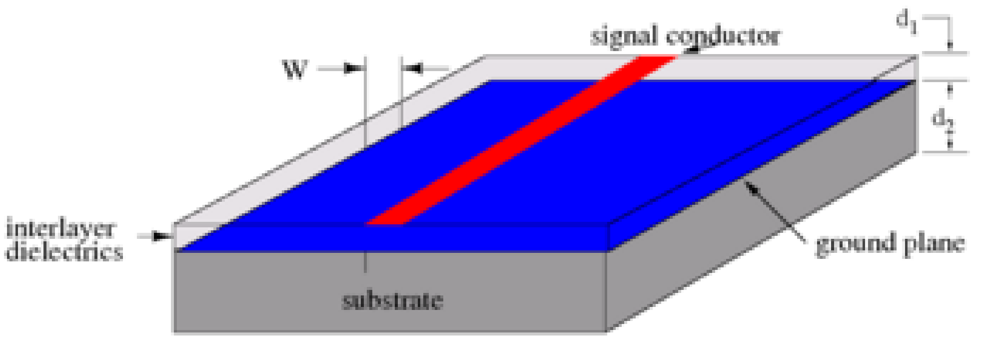
- Integral Equetion Method
- Galerkin’s Method in Spectral Domain
- Finite Difference Methods
- Modified Conformal Transformation Method
- Variational Method in FTD
- Boundary Element Method

Microstrip

- Advantages
  1. Fabricated using printed circuit board(PCB) technology
  2. Components such as antennas,couplers,filters,power deviders,… can be formed from microstrips
  3. Far cheaper than traditional waveguides
  4. Lighter and more compact
  5. Microstrips are very similar to striplines and coplanar waveguides and it is possible to integrate all three on the same substrate

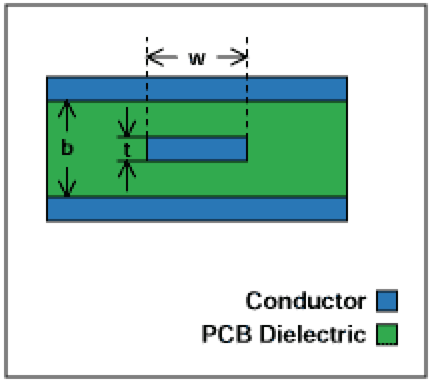
Microstrip

- Disadvantages
  1. Lower power handling capacity
  2. Higher losses
  3. Susceptible to crosstalk
  4. Unintentional radiation



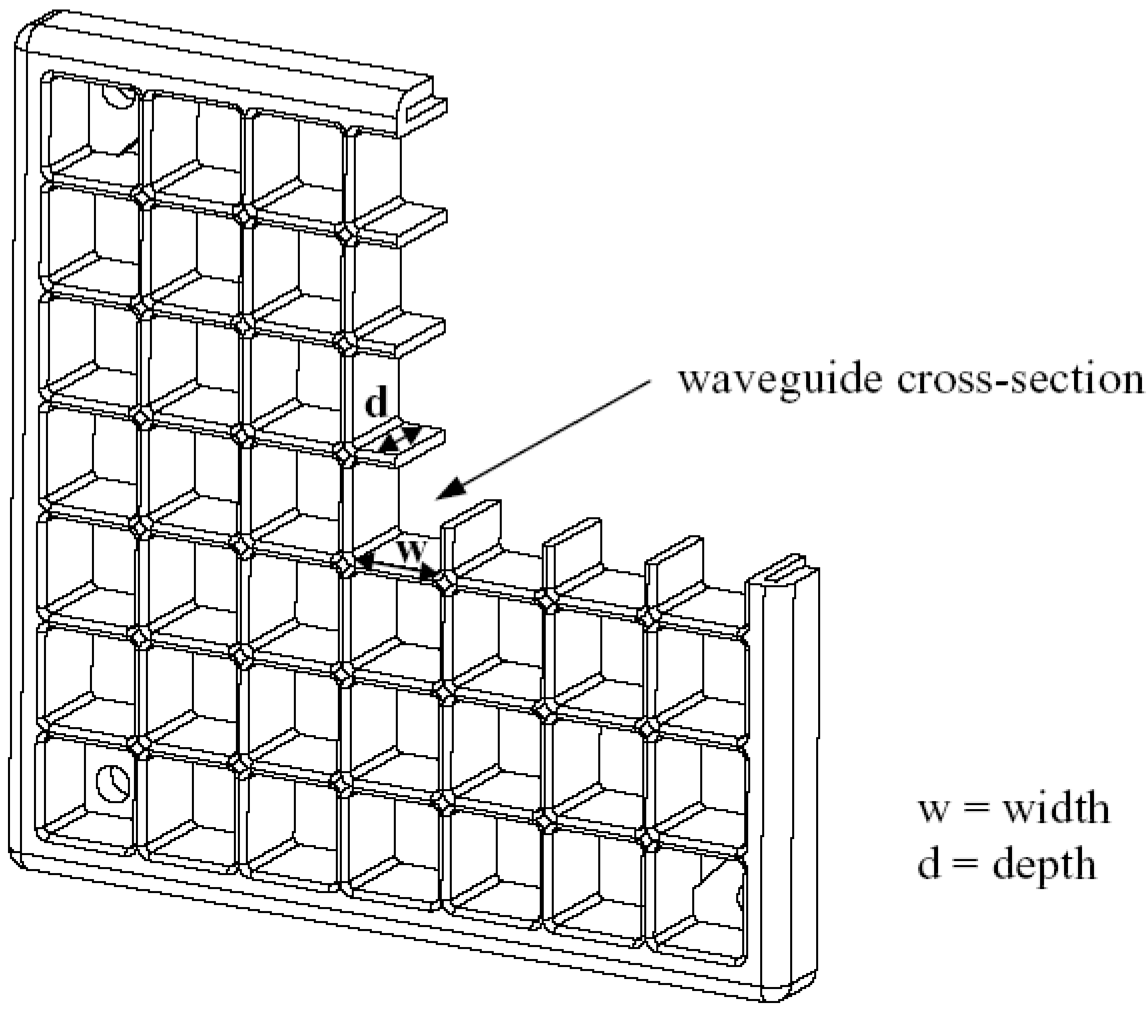
Strip Line

- Invented by R.Barret in 1950
- Advantages
  - Non dispersive
  - No cutoff frequency
  - No crosstalk
- Disadvantages
  - Much harder to fabricate than microstrip
  - More expensive
  - The strip width is very narrow

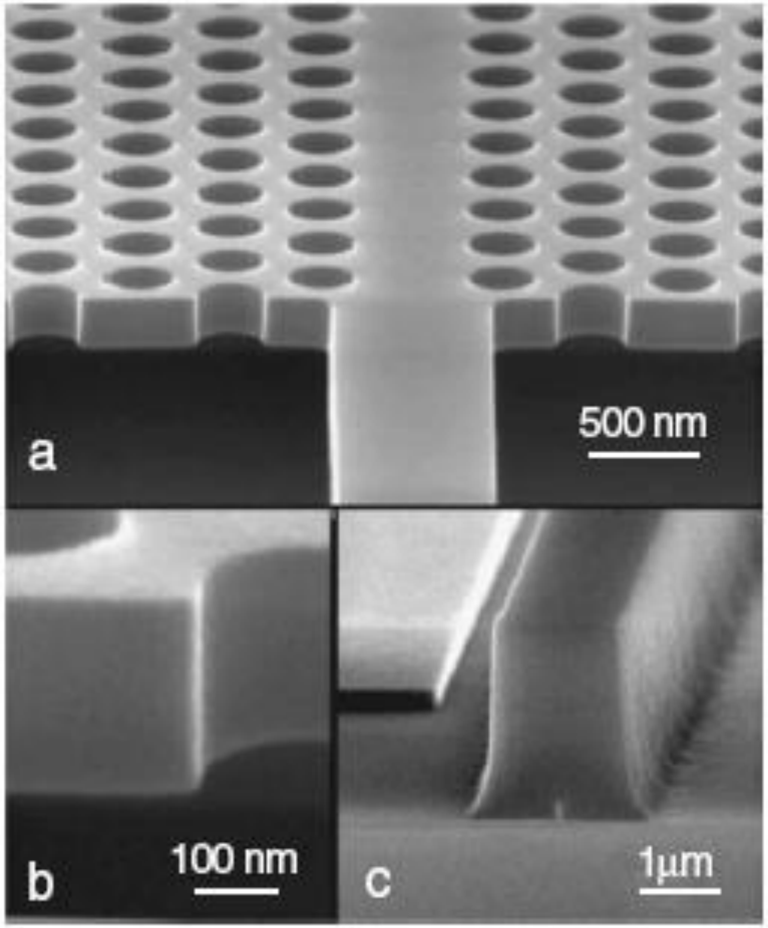


Waveguide array

Waveguide array



New silicon Dielectric Waveguides



منابع

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با تشکر از حضور شما