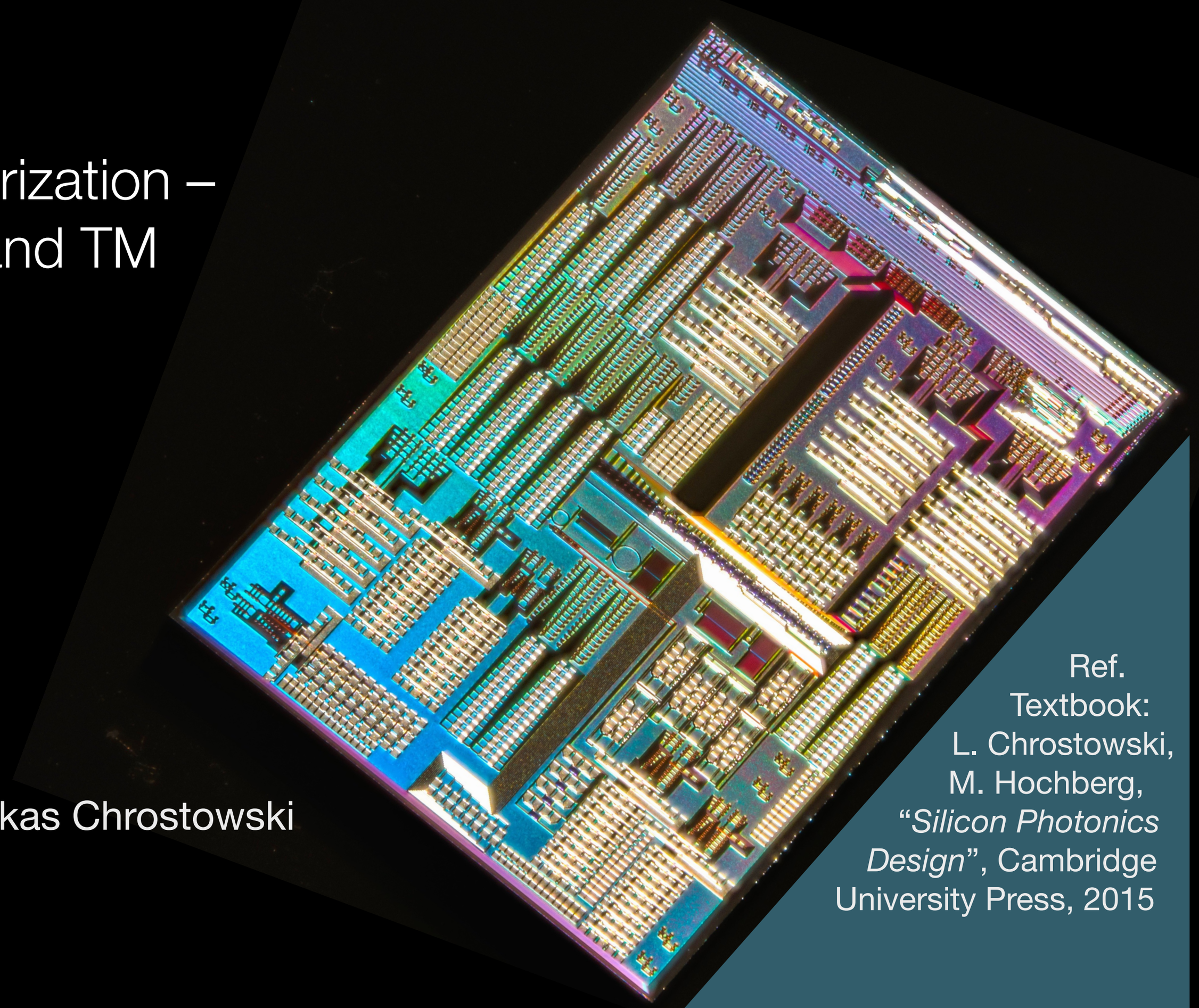
Polarization – TE and TM

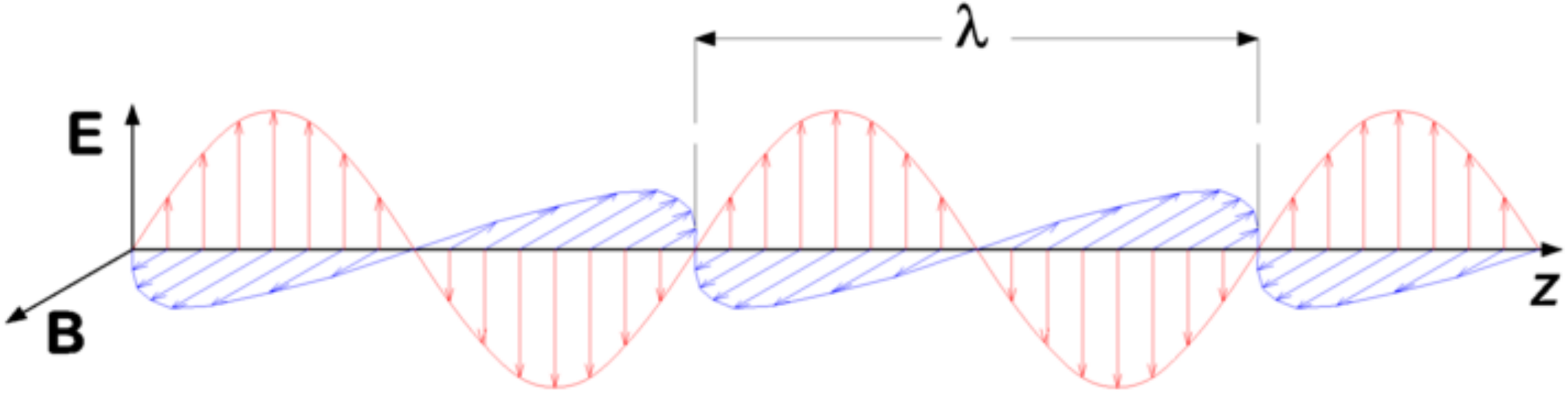


Dr. Lukas Chrostowski

Ref.
Textbook:
L. Chrostowski, M. Hochberg, "*Silicon Photonics Design*", Cambridge University Press, 2015

Electromagnetic Wave

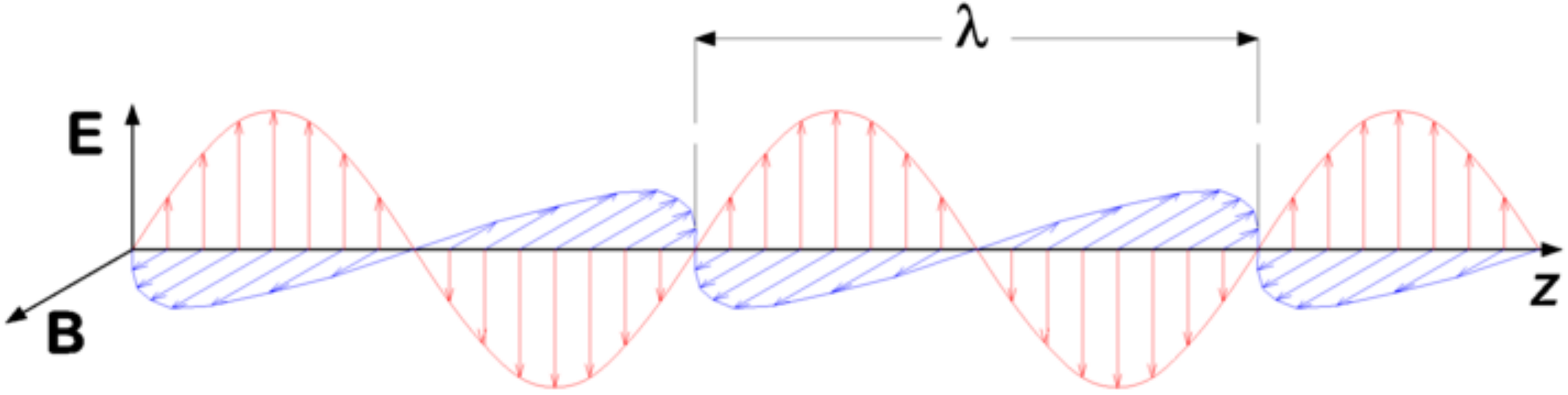
- Synchronized oscillations of electric and magnetic fields that propagate at the speed of light. The oscillations of the two fields are perpendicular to each other and perpendicular to the direction of energy and wave propagation (**z**, below), forming a transverse wave.
- Read more: https://en.wikipedia.org/wiki/Electromagnetic_radiation



https://en.wikipedia.org/wiki/Polarization_(waves)

Polarization

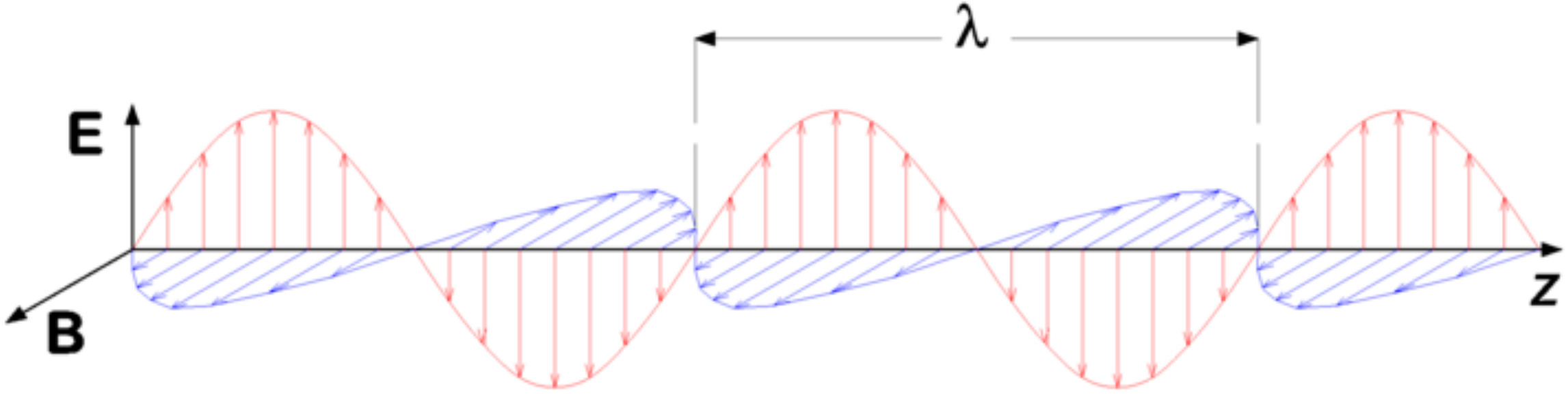
- Polarization of light refers to the direction in which the electric field is oscillating.
- In free space, a plane wave has the electric (E) and magnetic (H) fields oscillating transverse, or perpendicular, to the direction of propagation; this is called a transverse electromagnetic wave (TEM).



https://en.wikipedia.org/wiki/Polarization_(waves)

Linear Polarization

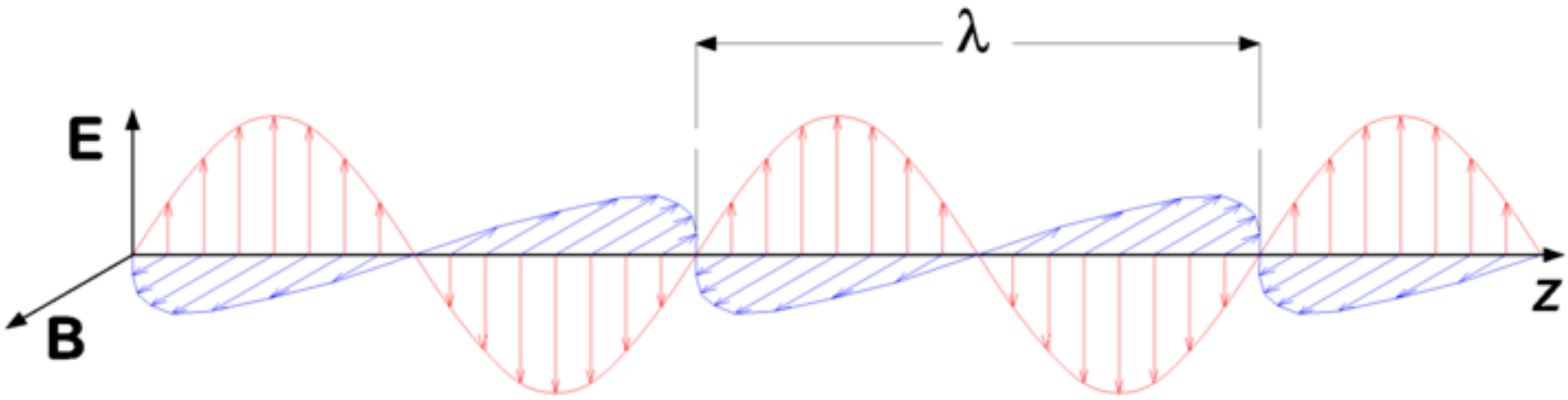
- Where the E and H fields each oscillate in a fixed plane, like in the following diagram
  - E is always oscillating vertically.
- In silicon photonics, we generally talk about linear polarized light.



https://en.wikipedia.org/wiki/Polarization_(waves)

Polarization – “vertical”

- A "vertically polarized" electromagnetic wave of wavelength λ has:
  - The electric field vector E (red) oscillating in the vertical direction.
  - The magnetic field B (or H) is always at right angles to it (blue)
  - Both are perpendicular to the direction of propagation (z).



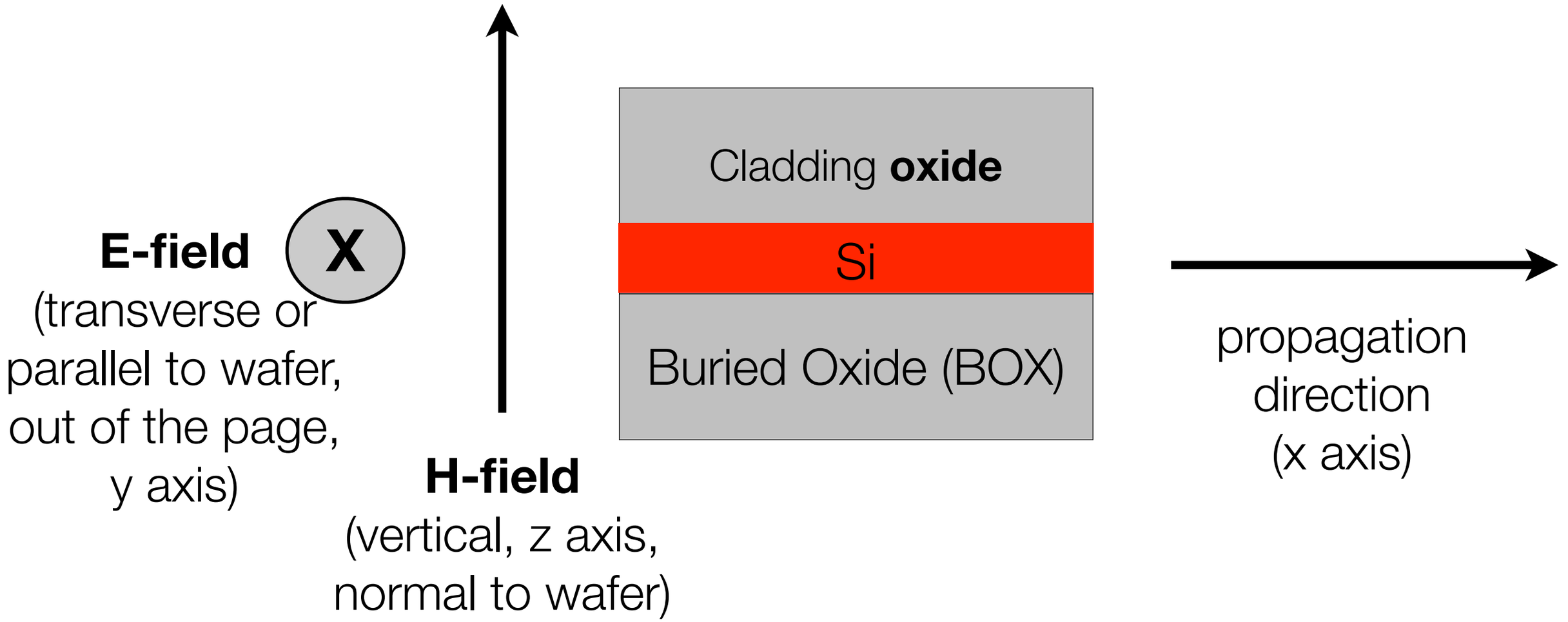
https://en.wikipedia.org/wiki/Polarization_(waves)

Polarization – in waveguides

- Polarization of light refers to the direction in which the electric field is oscillating.
- In waveguides, we define transverse as perpendicular to the direction of propagation, and parallel to the wafer surface.
    - The transverse electric (TE) polarization is defined as having the electric field transverse to the direction of propagation, and parallel to the wafer surface.
    - The transverse magnetic (TM) polarization has the magnetic field oscillating parallel to the wafer surface.

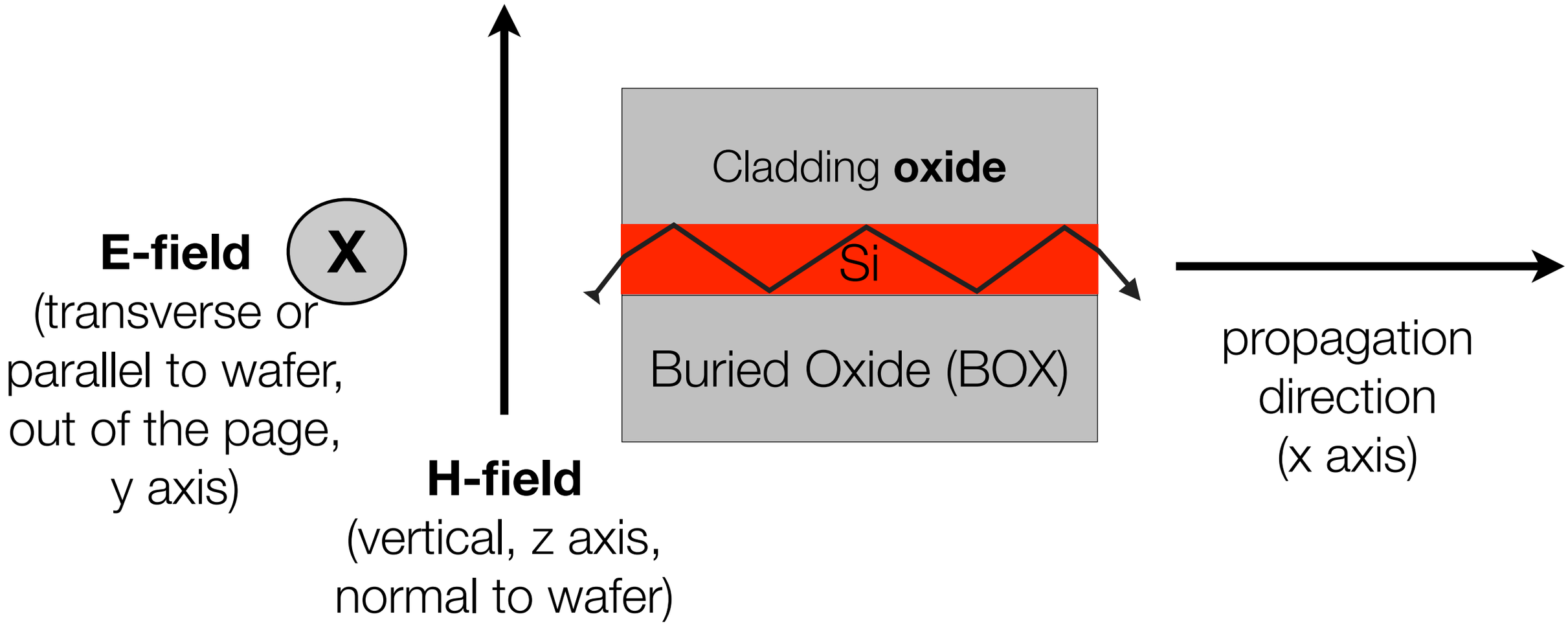
TE Polarization – in a slab waveguide

- The transverse electric (TE) polarization is defined as having the electric field transverse to the direction of propagation, and parallel to the wafer surface.



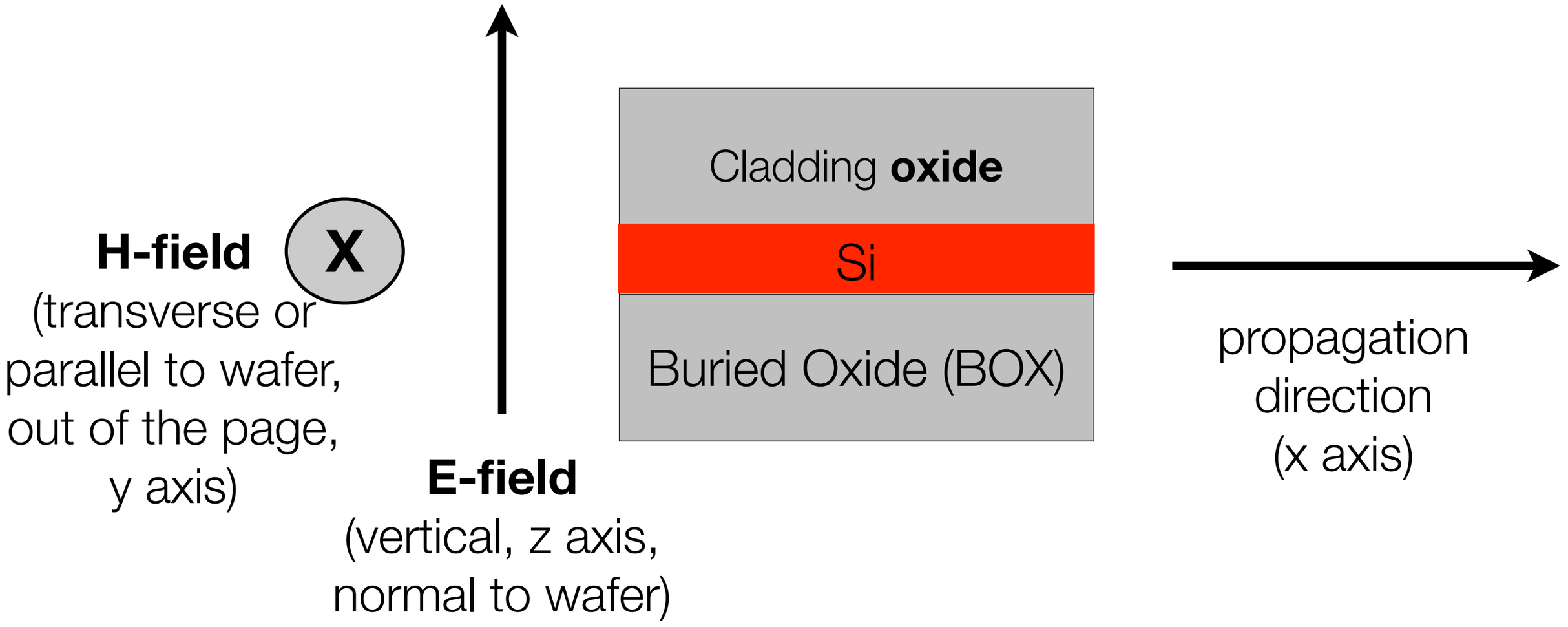
TE Polarization – in a slab waveguide

- The transverse electric (TE) polarization is defined as having the electric field transverse to the direction of propagation, and parallel to the wafer surface.



TM Polarization – in a slab waveguide

- The transverse magnetic (TM) polarization has the magnetic field oscillating parallel to the wafer surface.



TM Polarization – in a slab waveguide

- The transverse magnetic (TM) polarization has the magnetic field oscillating parallel to the wafer surface.