Types of Microscopy

Note: this table is intended as a simple guide. Actual performance and usage may be different in certain applications.

Type	Probe	Technique	Best Resolution	Penetration	Uses and Constraints
Optical Microscopy	Visible Light	Detect reflected light (opaque samples) or transmitted light (transparent samples). Light focused using lenses.	~200 nm	Surface or volume (can probe through transparent materials)	
Near-Field Optical Microscopy (NSOM)	Visible Light	Detect reflected light (opaque samples) or transmitted light (transparent samples). Uses an aperture very close to the sample surface.	~10 nm	Surface or volume (can probe through transparent materials)	Biological samples.
X-Ray Microscopy (TXM, SXM, STXM)	X-Rays	Image derived from x-ray scattering or interference patterns. X-rays focused using a “zone plate” (Fresnel lens).	~20 nm	Surface or volume (x-rays can penetrate some materials)	Can be tuned to specific frequencies to provide element identification and mapping.
Scanning Electron Microscopy (SEM)	Electrons	Detect electrons back-scattered by the sample. Electrons focused using electromagnets.	~1 nm	Surface	Sample must be in a vacuum.
Transmission Electron Microscopy (TEM, STEM)	Electrons	Detect electrons scattered as they move through the sample. Electrons focused using electromagnets.	~0.05 nm	Volume	Samples must be <100 nm thick.
Focused Ion Beam (FIB)	Ions	Detect ions back-scattered by the sample. Ions focused using electromagnets.	~10 nm	Surface	Due to the large masses of the ions, this probe can be destructive to the surface of the sample. Therefore, it can also be used to etch the sample.
Scanning Tunneling Microscopy (STM)	Cantilever Tip	Detect the quantum tunneling current of electrons from the sample to the probe tip.	~0.1 nm	Surface	Sample must be conductive material and must be in a vacuum. Can be used to manipulate atoms on the sample surface.
Atomic Force Microscopy (AFM)	Cantilever Tip	Detect the electrostatic force between the sample and the probe tip.	~0.1 nm	Surface	Can be used to manipulate atoms on the sample surface.
Magnetic Force Microscopy (MFM)	Cantilever Tip	Detect the magnetic force between the sample and the probe tip.	~10 nm	Surface	Sample must be ferromagnetic or paramagnetic.