1. What classes of materials are somewhat problematic to examine by scanning tunneling microscopy that are more easily studied by atomic force microscopy?

Since STM relies on a tunneling electric current between the tip and the sample under an applied bias, it is not well-suited for semi-conducting and insulating materials. Some of these can be studied, though, if they are sufficiently thin and deposited on a conducting substrate.

2. In three to six sentences, compare the relative strengths and weaknesses of optical, electron beam, and ion beam lithographies.

Optical lithography is by far the most pervasive approach, with well-developed optics, resists, and mask technologies. The ability to use masks makes it a very fast approach, but the main limitation is the diffraction-limited resolution as determined by the wavelength of the light (hundreds of nanometers). Ion and electron beam lithographies are primarily scanning techniques and thus slower than optical lithography. They have much better resolution than optical lithography, though (~10 nm for e-beam and a few times larger for ions). Ion lithography is also limited in that electrostatic, rather than magnetic, “optics” must primarily be used.