CHE323/384 Chemical Processes for Micro- and Nanofabrication
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Homework #9

1. We are designing a process to produce aluminum metal lines of pitch 1.0 μm and height 0.5 μm. Assume that the metal linewidth and spacewidth are equal (that is, 0.5 μm each, as measured at the top of the metal lines). Since the etch process may have some etch bias, the resist pattern used can have a linewidth different from the spacewidth, though the minimum lithographic dimension (for either the line or the space) is 0.25 μm.
    a. What minimum degree of anisotropy is needed in an etch process in order to produce such a structure?
    b. What minimum pitch could be obtained for such a structure with wet etching? (Again with minimum lithograph dimension is 0.25 μm, metal thickness is 0.5 μm, and we want equal metal width and spacing as measured at the top.)

2. In a particular etch process, which type(s) of dry etch equipment should be used?
    a. If selectivity is the biggest concern
    b. If the biggest concern is ion bombardment damage
    c. If the biggest concern is obtaining vertical sidewalls
    d. If the biggest concerns are selectivity and vertical sidewalls
    e. We want it all: selectivity and vertical sidewalls and low ion damage, while maintaining a reasonable etch rate?

3. Consider an isotropic etch with infinite selectivity. The film being etched has a nominal thickness d, but this thickness varies by ±30% due to topography. If a 50% overetch is used (that is, the etch time is set to be 50% longer than that required to just etch through the nominal film thickness) in order to ensure complete etching, what is the worst-case undercut distance?

4. When etching an oxide contact hole with a given process, the etch selectivity compared to photoresist is found to be 2.5. If the oxide thickness to be etched is 140 nm and a 50% overetch is used, what is the minimum possible photoresist thickness (that is, how much resist will be etched away)? For what reasons would you want the resist to be thicker than this minimum?