Lab #6 (Sputtering) Assignment

Due by Monday 2017/04/10 at 1:30 pm.

This assignment consists of EIGHT questions in total.

Sputtering Technique:

First, search “Lesker Tech” on the web and read the Lesker tech notes volume 7 on “sputtering yields and rates”.

Next, find the “Lesker PVD-75 Manual” on the web. It is over 300 pages (not the four page overview) and will serve as a reference for this assignment. Specifically, check under “Sputtering Sources” which describes the operation of the Torus^{TM} sputtering guns installed on our system.

1. Our PVD-75 system is equipped with three-inch diameter Torus^{TM} sputter guns: one aluminum target (with a DC supply capable of up to 500W), one TiO_2 target (with an RF supply capable of up t 300W), and one SiO_2 target (with a separate RF supply capable of up to 300W). Determine the probable maximum power at which each gun can operate. Show calculations and assumptions.

2. The rate of TiO_2 film growth is currently very low. To increase the rate it is proposed to move the sputter guns closer to the substrate deck (halving the throw distance). What are the MAJOR pros and cons of doing this? Do not just list the ones from the article, but rather describe what it REALLY means in understandable terms (i.e. do not regurgitate “compressive stress” but rather explain what that means). Film stress isn’t a major problem regardless, concentrate on OBSERVABLE effects that you’d expect to see in the final film!

3. Describe three methods of lighting a stubborn RF sputtering target in detail. Be sure to outline any key parameters such as gas pressure, etc. specific to our PVD-75 system.

4. An aluminum target used with a DC supply was recently changed. When powered-up, the target failed to ignite and looking at the power supply the voltage was zero volts but the current was 1 Amp. What is the likely problem?

5. Using a good reference for deposition materials, determine, for each of the following materials, if DC or RF sputtering must be used: Aluminum, ZnO, TiO_2, SiO, SiO_2, Silicon, Cryolite

6. During reactive sputtering, what is ‘target poisoning’. Give the specific example of the use of a pure aluminum target to produce a film of aluminum oxide. How is it known that a target is poisoned (what is observable by the operator) and what is the fix from an operator’s standpoint?

Design:

In the lecture notes, a quarter-quarter using MgF2 (n=1.38) and Al2O3 (n=1.7) was examined. These coatings can be produced with almost any available dielectrics, though

7. Using FilmStar, design an optimal antireflective V-coating for 532nm using SiO and ZnO dielectrics. Research the indices of refraction from a thin-film materials supplier (cite the source) and choose materials (letters) in FilmStar which are as close as possible to these. The ZnO film is, however, oxygen deficient and so the resulting index of refraction is 1.7. The reflection at the design wavelength must be well under 0.5%. Submit a FilmStar report outlining the design and be sure to include your name in the graph title.

8. Using FilmStar, design an optimal antireflective V-coating for 532nm using SiO_2 and TiO_2 dielectrics. Research the indices of refraction from a thin-film materials supplier (cite the source) and choose materials (letters) in FilmStar which are as close as possible to these. The reflection at the design wavelength must be well under 0.5%. Submit a FilmStar report outlining the design and be sure to include your name in the graph title.