Practice quiz Optical surface profile measurement

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Questions:

0 points possible (ungraded)

1. What are the limitations or drawbacks of white light interferometric measurements?

- [ ] The lateral scanning of the surface profile makes this kind of measurement slow.
- [x] The sample surface needs to be sufficiently reflective.
- [ ] Only rigid samples can be measured.
- [x] Steep slopes on the sample surface cannot be measured.

✔

Explanation

In order to obtain interferences, the reference beam must be combined with the object beam. The object beam is reflected from the sample. If the sample is not reflective enough (transparent or absorptive), interferences do not occur. Similarly, when the slope is too steep, the reflected light may not be collected by the objective lens, which would result in the absence of interferences and therefore in the absence of measurement.
WLI measurements are fast as no lateral scanning is needed, only scan in z-direction.
Any kind of sample can be used as long as it is reflective enough.
For further information, please see video “Optical surface profile measurement” at 00:51.

2. Which of the following statements regarding optical surface profilers are true?

- [ ] Laser beam surface profiler is best suited to be used to measure the depth of a KOH etched silicon cavity.
- [ ] The laser beam surface profiler has the same measurement mechanism as the white light interferometer, but light sources are different.
- [x] The profile measured by the laser beam surface profiler is only a line scan instead of a 3D surface profile.
- [x] The white light interferometer cannot measure the profile at a very steep sidewall.

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Explanation

The laser beam surface profiler can only measure a single line scan across the entire wafer. To measure the depth of a KOH etched silicon cavity, the laser beam scan line has to be aligned to the silicon cavity on the wafer. Since it is mainly designed to measure the wafer bending, there is no optical microscope integrated in most laser beam surface profilers. Hence, it is not always possible to perform the alignment. WLI is best suited to be used to measure the depth of a KOH etched silicon cavity. The mechanism and the light source are both different between the laser beam surface profiler and the WLI. The laser beam surface profiler uses single wavelength laser and detects the change in the angle of reflection. On the other hand, the WLI uses white light and detects the interference, and is not able to detect the light coming from a very steep sidewall because of limited vision field.
For further information, please see video “Optical surface profile measurement” at 00:51, 02:52 and 06:58.

3. Why is it important to measure the stress of thin films that are used in a micro fabrication process?

- [x] The stress of the thin film could induce a significant wafer bow, which might impact processes such as photolithography, wafer bonding, etc.
- [x] In mechanically released moving parts in MEMS devices, the stress of thin films is correlated to the mechanical properties of the released part

mechanical properties of the released part.

- [ ] By measuring the thin film stress, the adhesion force between the substrate and the thin film can also be obtained.
- [ ] By measuring the thin film stress, the performance of the thin film deposition process is monitored.

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Explanation
A very poor adhesion between a thin film and the substrate indeed will affect the level of wafer bending, but measuring the wafer bending or the film stress does not tell how well the film adheres to the substrate..
The thin film stress measured and calculated by laser beam surface profilometry is not accurate enough to monitor the performance of the thin film deposition. The film thickness or the refractive index are usually measured to monitor the performance of the deposition.
For further information, please see video “Optical surface profile measurement” at 06:30.

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