Measurement of FIB SiO2 deposition using Optical Beam Induced Current

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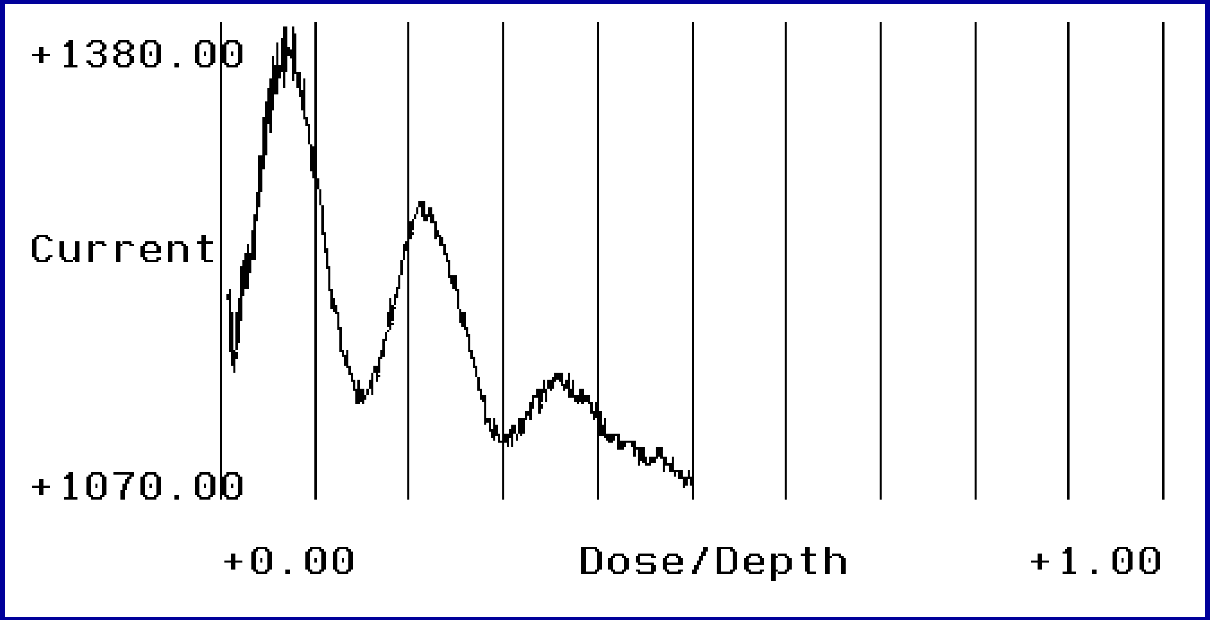
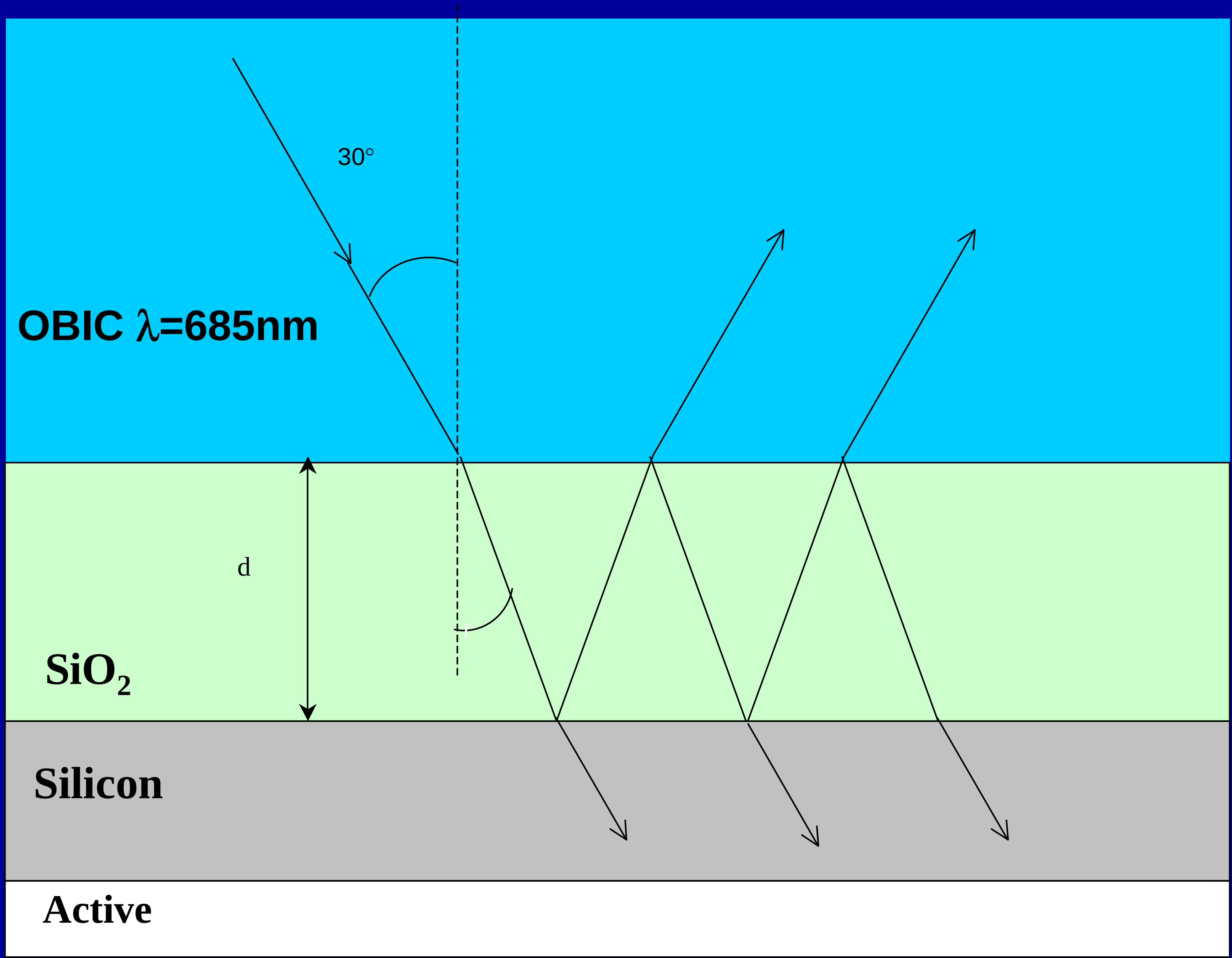
Description

- If the OBIC signal is monitored as SiO2 is deposited oscillations are observed in the signal .
  A straightforward analysis shows that extrema in the signal are caused by interference effects in the thin film SiO2 layer and occur at SiO2 thicknesses of 250nm, 500nm, 750nm, etc.



Outline



Explanation

- Book value for the refractive index of SiO_2 is 1.46. It is to be expected that the refractive index of the FIB-grown material differs from this somewhat.
- By Snell's Law the angle of refraction in the SiO_2 is 20.0 degrees.
- Standard thin film theory (see for example Heavens *"Optical Properties of Thin Solid Films"* (Dover, 1991) pp55-59) the power transmitted through the film is given by:

$$\frac{n_2 t_1^2 t_2^2}{(1 + 2 r_1 r_2 \cos(2\delta_1) + r_1^2 r_2^2)}$$

- where the *r*s and *t*s are the reflection coefficients between the various interfaces (dependent upon polarization) and δ_1 is the phase change cause by waves traversing the SiO_2 film twice:

$$\delta_1 = \frac{2\pi}{\lambda} n_1 d_1 \cos\phi_1$$

- Using n=1.46, wavelength=685nm, angle=20 degrees the period of the oscillations is ~500nm, with the first maximum occurring at 250nm.

- Since the OBIC signal is proportional to the power reaching the active area this period will be reflected directly in the OBIC signal. The OBIC signal will be superimposed on a falling background signal caused by absorption in the increasingly thick SiO_2 film.