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LETTER TO THE EDITOR

A NEW APPROACH FOR REFRACTIVE INDEX MEASUREMENT OF THE DOUBLE LAYER POLY-SILICON FILMS

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Interferometry approach for the index refraction measurement of the poly-Si films is proposed. Only spectral values ω_{Rmin}, ω_{Rmax} which are related to reflected values R_{min}, R_{max} are measured. Beside pure scientific investigations this approach can be used for routine control of the poly-Si films.

At constant photon energy the refractive index n of poly-Si films increases with decreasing deposition or annealing temperatures. Electron diffraction and electron spin resonance investigations indicate that the refractive index is correlated with grain size. Brodsky[1] reported a maximum variation of n from 3.25 to 3.72 when annealing temperatures varies. More recent investigations[2,3,4] reported changes in refractive index measurement by using different methods.

In addition to this paper a new approach for measurement of refractive index n of poly-Si films by using only values of the spectral positions ω_{Rmin}, ω_{Rmax} of the extrema R_{min}, R_{max} (reflected spectrum) is proposed. Moreover, examination of the same samples by the cross-sectional electron microscopy technique, revalues a close correlation of the refractive index with the crystalline grain size and hence with crystal quality of the poly-Si films.

By using a Perkin-Elmer 180 Spectrophotometer, reflected spectra is measured (see Figs. 1 and 2). In Table 1 experimental results of TEM cross-section examination of system P-Si/SiO_2/C-Si are shown. Two of the samples are shown in Fig. 3. In the sample a) near the surface of SiO_2 are relatively small crystallites, but bigger than those when the film was developed under higher pressure.

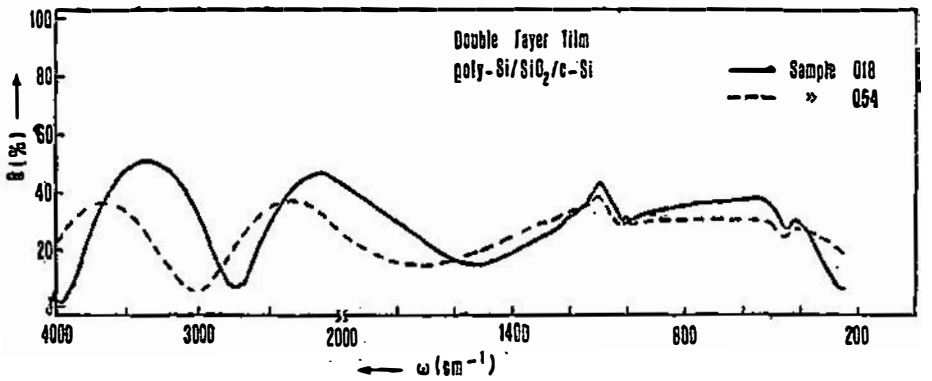

Fig. 1. Spectral results for samples 018 and 054 obtained by reflected spectra.

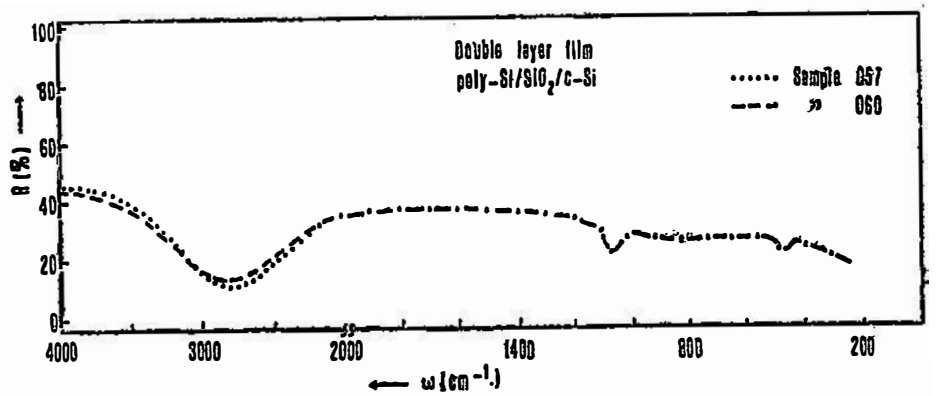

Fig. 2. Spectral results for samples 057 and 060 obtained by reflected spectra.

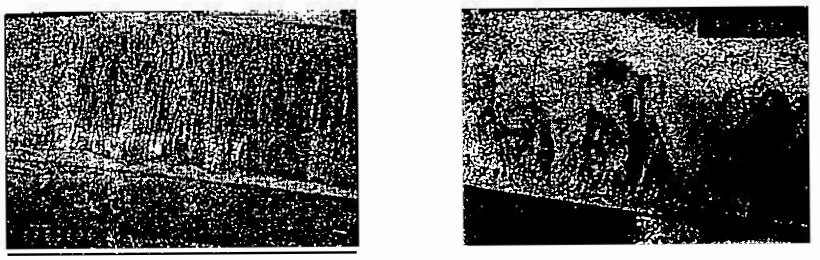

Fig. 3. Pictures of the two samples for different crystallites.

On the surface of the film these crystallites become bigger and have the shape of the teeth (as is shown in the sample b)).

Applying the proposed method we found the values of n as are given on Table 1. Analysing results yields an important conclusion: As the pressure becomes higher, under the same temperature of preparation, the crystallites become smaller and the refractive index n become bigger.

TABLE 1.

Sample N	Poly-Si (m)	SiO (nm)	Roughnes d (nm)	Grain size G (nm)	n	Pressure of SiH (Pa)	Temperature of deposition
018	1.15	123	40	4	3.59	26.666	630
054	1.15	105	90	450	3.26	0.353	630
057	0.67	110	90	150	3.28	0.387	590
060	0.61	96	40	116	3.53	1.333	590
RB 085	0.601	100			3.99	5.333	630
RB 084	0.670	100			3.56	13.333	630

The characteristics of some samples of a system P-SiO/C-Si, by TEM cross-section, the conditions of preparation and the calculated n.

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NOV PRISTUP ZA MJERENJE INDEKSA LOMA DVOSLOJNIH POLY-S FILMOVA

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Predložen je jedan interferometrijski pristup za mjerenje indeksa loma dvoslojnih poli-Si filmova. Mjerene su samo spektralne vrijednosti $\omega_{R\min}$, $\omega_{R\max}$, koji odgovaraju vrijednostima $R_{\min}$, $R_{\max}$ reflektiranog spektra. Smatramo da je navedeni pristup efikasan za rutinsku kontrolu poli-Si filmova mnogoslojnih sistema.