# Silicon carbide doping by ion implantation and excimer laser annealing.

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Silicon carbide SiC has been given great attention in high power, high temperature and high frequency device applications due to its large band gap energy, large electric breakdown field, high saturated electron drift velocity and large thermal conductivity. Great progress have been made recently on the manufacture of integrated circuits on this kind of material. The technological problems are numerous and generally related to the refractory character of the material. All thermal treatments need substantial temperature increase compare to silicon technology. As an alternative to classical thermal treatment, excimer laser processing has already shown good potentialities to incorporate and activate the dopants. Indeed the use of high powerful pulsed lasers in the nanosecond duration regime allows to deposit a large amount of energy in short time in the near surface region while keeping the substrate essentially at room temperature. For SiC, its allows to reach melting point and so, complete activation of dopants can be achieved.

SOPRA has a long experience in the development of high power excimer lasers since 15 years. The VEL model used in this study is a XeCl laser which can provide 15J per pulse in a duration of about 180ns. Excellent pulse to pulse stability ( <3%) allows to anneal large size surfaces with a good homogeneity. As shown in the thermal simulation reported in Figure 1, high energy per pulse is mandatory for SiC if one wants to avoid pulse overlap on the same dye for the future IC's.

SOPRA is also very well known in the field of thin film metrology with its spectroscopic ellipsometers used as reference instruments to measure layer thickness and optical indices. Accurate characterization of large band gap semiconductors like SiC require extension of the spectral range in the vacuum uv (vuv) to detect the optical transitions characteristic of the semiconductor band structure. SOPRA has developed recently a vuv ellipsometer for 157nm lithography which will be used in this study. As shown in the measurement reported in Figure 2, well defined optical transitions characteristic of the crystalline character of SiC are detected around 160nm.

The proposed paper will present an experimental study of SiC doping by ion implantation and excimer laser annealing. The process is optimized using precised structural informations obtained by spectroscopic ellipsometry, Rutherford backscattering and x-ray diffraction. Electrical results will be related to the structural informations.

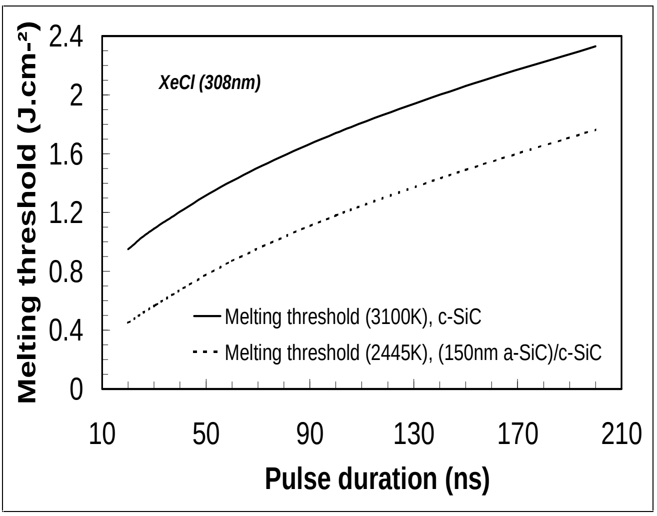

Figure 1: Melting threshold of crystalline c-SiC and 150nm amorphous SiC on c-SiC as a function of pulse duration.

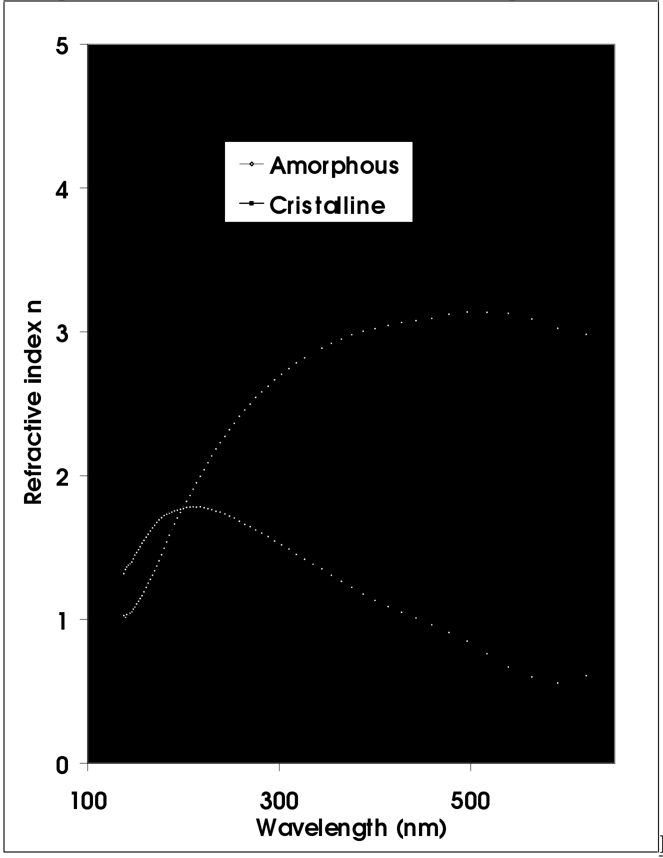

Figure 2: Optical indices of crystalline and amorphous SiC. Optical transitions are detectable in the vuv range (arrows on the figure)