# MASK-FREE LOCALIZED GRAFTING OF ORGANICS AT A MICRONIC OR SUBMICRONIC SCALE ON COMPOSITE SUBSTRATES.

J. CHARLIER AND S. PALACIN
*CEA-SACLAY, DSM/DRECAM/SPCSI, 91191 GIF CEDEX, FRANCE*
*E-mail: charlier@drecam.cea.fr*

S. AMEUR AND C. BUREAU
*Alchimer S.A., Paris Club d'Orsay Université, 91893 Orsay Cedex, France*
*E-mail: christophe.bureau@alchimer.com*

J. P. BOURGOIN
*CEA-SACLAY, DSM/DRECAM/SPCSI, 91191 GIF CEDEX, FRANCE*
*E-mail: jbourgoin@cea.fr*

This work presents a new one-step process, enabling the mask-free localized functionalization by organics of the conducting or semiconducting parts of composite surfaces at a micronic or submicronic scale. The functionalization is carried out via the electro-grafting of suited precursors, which guarantees that the resolution is that of the pre-existent pattern, even when the whole surface is dipped into the reaction medium. The presumed mechanism is that of a regio-selective extraction of electrons from the surface, according to its apparent, local, work function in solution. Three samples series are considered: (i) "macroscopic" samples of composite surfaces (Si with native oxide layer or thick silica covered on half by gold); (ii) "microscopic" samples (interdigited gold combs on thick silica with different distances between two subsequent electrodes (128, 32, 8 and 0.5µm)); and (iii) microelectronic substrates (n/p diode sensors with a pre-existent pattern at a micronic scale). On each sample, the localization of the organic grafts is studied by XPS, IR and AFM methods.

This process was also applied successfully on homogeneous silicon samples which present a pre-existent pattern of doped silicon (figure 1). We obtained a selective electrografting as a function of the doping of the substrate. Indeed, if we manage to reveal the scheme of implantation of the wafer after electrografting (figure 2a), the electro-initiated film obtained is thicker on the slightly doped parts of the sample than on the strongly doped parts. It would seem that the difference in behavior between the strongly and the slightly doped zones of the sample is due, in fact, to the nature and/or the thickness of the native oxyde which covers the wafer. If the wafer is treated by HF in view to obtain a Si-H type substrate, and if we apply the same electrolytic treatment as previously, the surface of the substrate, after electropolymerisation, becomes homogeneous (figure 2b).

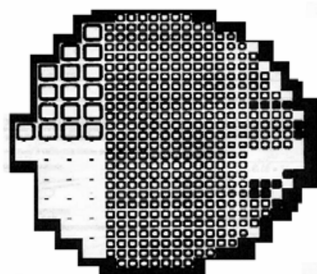

*Figure 1: wafer of Si (100) n-type with strongly doped parts (in balck); ionic implantation: $P^{31+}$, 50KeV, $10^{15}$ at./cm$^2$*

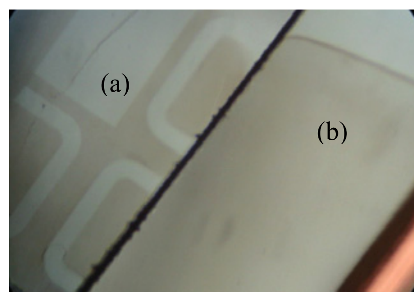


*Figure 2: (a) scheme of implantation revealed after electrografting, (b) Si-H type substrate after electrografting*