Highly doped amorphous silicon thin films as dopant source for nanoscale p/n junction

Low Cost Silicon Junctions

L.Ricardo [a,c], G.Lavareda [a,b], C.Nunes de Carvalho [a,c] , A. Amaral [c,d]

[a] Departamento de Ciência dos Materiais, FCT-UNL, 2825–114 Caparica, Portugal; [b] CTS, FCT-UNL, 2825–114 Caparica, Portugal; [c] Instituto de Ciência e Engenharia de Matéria e Superfícies - ICEMS, [d]Departamento de Física, Instituto Superior Técnico - IST, Universidade de Lisboa – UL, Av. Rovisco Pais 1, 1049–001 Lisboa, Portugal
l.ricardo@campus.fct.unl.pt

Abstract

The objective of this work is the study of a low cost alternative process to the usual silicon crystalline doping through the diffusion furnace technique. The novelty is the use of highly doped hydrogenated amorphous silicon thin films, acting as dopant sources. These films are deposited by Plasma Enhanced Chemical Vapour Deposition on doped crystalline silicon substrates of opposite majority charge carriers, originating pn junctions [1]. Afterwards, these samples are placed in the diffusion furnace in order to induce firstly the dehydrogenation of amorphous silicon (350º - 550ºC), followed by the dopant diffusion into the crystalline silicon [2]. This diffusion process occurs at temperatures ranging from 900ºC to 1000ºC, for different dopant concentrations. The p-n junctions characterization were made by: I(V) curves; four-point probe measurements and SIMS analysis in order to obtain the electrical PV parameters (short circuit current, I_{CC}, and open circuit voltage, V_{OC}), diffused layer sheet resistance, and doping profile, respectively. Typical PV values measured are $V_{OC} \approx 0.51$ V and $I_{CC} \approx 13$ mA/cm^2, obtained for a junction depth of 2.3 µm and sheet resistance of 50 Ω/sq. These results are promising however they must be optimized improving the electric contacts of these junctions.

References

[1] Lavareda G., Calheiros Velozo A., Nunes de Carvalho C., Amaral A., *Thin Solid Films* 543 (2013) 122-124.

[2] Calheiros Velozo A., Lavareda G., Nunes de Carvalho C., Amaral A, *Thin Solid Films* 543 (2013) 48-50.