Electroless nickel nucleation on textured silicon substrate

Hanane El Belghiti[a,b], Marthe Ndjeri[b], Damien Aureau[b]
Muriel Bouttemy[b], Elise Delbos[a,b], Arnaud Etcheberry[b]

[a] OMG Ultra Pure Chemicals
Les Vielles Hayes, F-50620 Saint-Fromond
[b] Institut Lavoisier de Versailles,
45 avenue des Etats-Unis, F-78035 Versailles Cedex

ABSTRACT

The increase of the efficiency solar cells is of great interest for the scientific and industrial communities. Several researches are managed these years: new absorbers, use of textured silicon, etc. One of the other novel solutions is to replace silver contact lines, currently made with silver paste, by other materials and processes. Copper line electrodeposition is a good candidate. However, two main experimental challenges have to be overcome:

1- To avoid the copper diffusion throughout the silicon substrate, leading to the degradation of the solar cell efficiency.
2- To realize an electrical contact on silicon necessary to process copper electroplating.

One method to overmaster these two points is to deposit a nickel layer onto the silicon substrate by electroless. In this work, a commercial chemistry (Solar prep 903 processe from OMG Electrochemicals) was used.

Our purpose is to deposit a very well-controlled thickness electroless nickel to form a high efficiency nickel silicide contact after annealing. For that, an accurate understanding of the nickel electroless mechanism is necessary. The main step is to control the beginning of nickel nucleation at very short times.

Therefore, we propose a specific study dedicated to these preliminary steps, carried-out on textured PV silicon, with a multiple approach. The surface characterizations have been processed combining several methods: SEM imaging, XPS and nano-Auger. In addition, the evolution of the silicon open circuit potential versus time, in electroless nickel solution, was in-situ studied. We will present a correlation between the OPC value and the progressive nickel coverage of the silicon surface.

Monitoring the electrochemical behavior of silicon, before and after deposition, by cyclic voltammetry was also investigated. Fundamental aspects of the nickel electroless mechanism will be presented. All these results will be discussed through semiconductor electrochemistry concepts, in order to obtain an exhaustive description of the global process.

ACKNOWLEDGMENTS

This work has been carried out in the frame of the Bifasol project supported by the “Agence Nationale de la Recherche” (ANR-11-PRGE-004). The authors would like to thanks INES (Institut National de l’Energie Solaire) for providing silicon substrates.

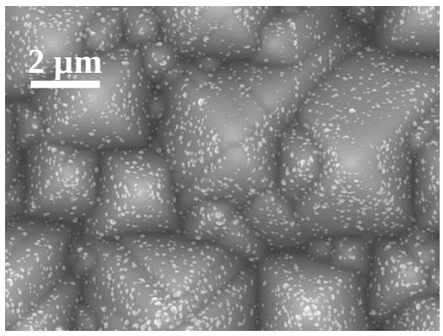

Figure 1: SEM-FEG micrography of the electroless deposited nickel layer ($t_{deposit}$=30 s) on textured Si substrate.

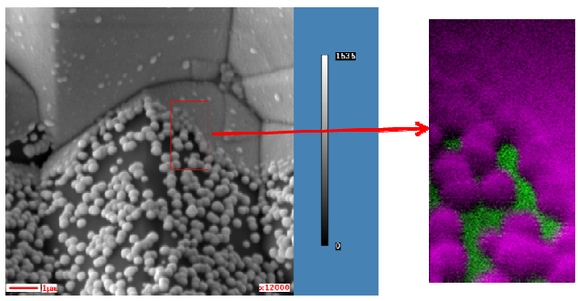

Figure 2: Nano-Auger localized cartography (spot size 12 nm) of the electroless deposited nickel layer ($t_{deposit}$=5min) on a textured Si substrate.

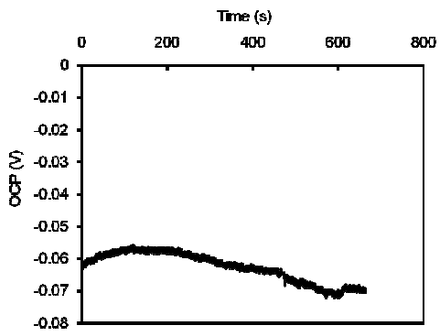

Figure 3: Evolution of the silicon open circuit potential as a function of the plating time, in nickel electroless chemisty.