Study of Selective PECVD of Silicon on Silicon Nitride and Aluminum Oxide

Ghewa Akiki,[1] Pavel Bulkin,[1] Dmitri Daineka,[1] and Erik V. Johnson[1]
[1] LPICM-CNRS, Ecole Polytechnique, route de Saclay, 91120 Palaiseau, France

Research in the field of area selective deposition currently focuses on the use of Atomic Layer Deposition (ALD) technique, and requires an initial nucleation delay between two different substrates, as well as a "passivation" step, namely a plasma etching step that resets the nucleation delay for one surface [1]. In analogy, we aim to demonstrate a Plasma Enhanced Chemical Vapor Deposition (PECVD) based approach using a non-sinusoidal voltage waveform [2] to excite an $Ar/SiF_4/H_2$ plasma. This plasma chemistry is believed to be a key ingredient to creating a varying nucleation delay as the surface processes depend on the deposition/etching balance controlled by the H_2 flow rate [3]. As a building block for our PECVD based approach, we report on the observation of a nucleation delay for a PECVD process for microcrystalline silicon films on two different substrates, first using a standard 13.56 MHz radio frequency excitation source. The deposition selectivity on a patterned chip containing both SiN_x and AlO_x areas as well as the influence of the plasma parameters, will be presented. The analysis is performed by comparing ex-situ ellipsometry spectra before and after deposition (Fig.1) and by Scanning Electron Microscopy (SEM) micrographs.

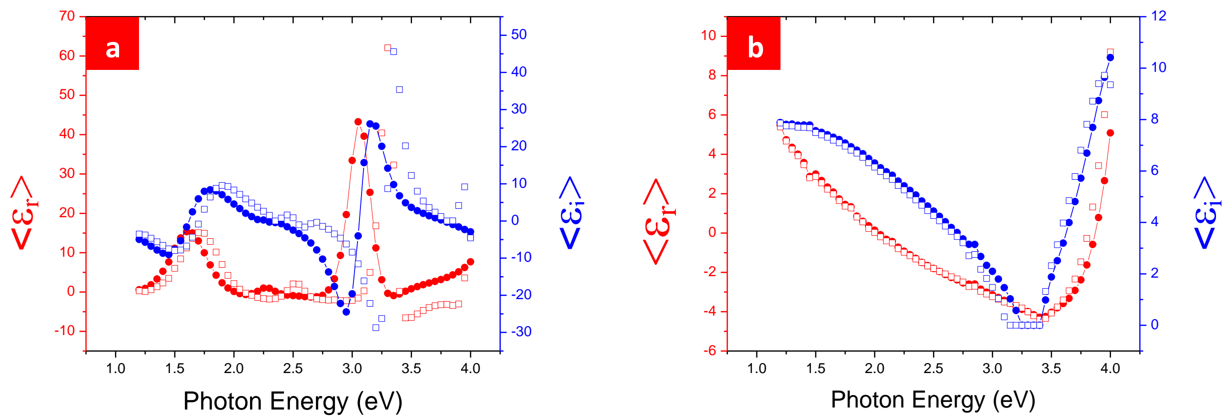

Fig 1 Comparison of ellipsometry spectra for (a) Silicon Nitride and (b) Aluminum Oxide substrates before (solid line) and after (dotted line) microcrystalline silicon film deposition

[1] R. Vallat, R. Gassilloud, B. Eychenne, and C. Vallée, **J. Vac. Sci. Technol. A 35,** 01B104 (2017)
[2] J. Wang and E.V. Johnson, **Plasma Sources Sci. Technol. 26** (2017) 01LT01
[3] Dornstetter JC, Bruneau B, Bulkin P, Johnson EV, Roca i Cabarrocas P, **J. Chem. Phys. 140**, 234706 (2014).