Fabrication steps towards a state-of-the-art 100 nm GaAs ultrathin solar cell

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III-V ultrathin solar cells, devices with absorber thicknesses of 200-300 nm or less, have been recently demonstrated with efficiencies approaching their standard thick counterpart. To achieve such results, advanced light trapping techniques have been exploited, leading to short-circuit current 50% higher than double pass absorption[1]. The most common approach is the combination of a flat front-side anti-reflection coating and the scattering of sunlight using back side subwavelength diffraction gratings. Using this strategy, solar cells with an absorber thickness of 205 nm and a periodic pattern[2], or 300 nm and quasi-random patterns[3] have been successfully fabricated with short-circuit currents (J_{SC}) of 24.6 and 26.4 mA/cm^2 and efficiencies of 19.9 % and 22.35 %, respectively.

Recently, we showed[4,5] a design for a 100 nm GaAs ultrathin solar cell (left figure) achieving an equivalent J_{SC} of 27.2 mA/cm^2, meaning an enhancement of 51.4% relative to double-pass absorption. In this work, we report the fabrication steps towards the fabrication of such a device. First, we discuss the fabrication protocol. Then, we present measurements on inverted solar cells with and without back side flat mirrors as well as the fabrication of the diffraction gratings to be applied to the final devices. The fabricated solar cells with a back reflector show very promising performance, with a J_{SC} of 11.6 mA/cm^2 (no ARC), a V_{OC} of 979 mV, a FF of 78% and an efficiency of 8.9% (center figure). The samples patterned with the diffraction grating (right figure) show very good aspect ratios and as-specified dimensions. These results are very encouraging towards the obtention of highly efficient ultrathin solar cells with state-of-the-art J_{SC} and efficiency. The latest results will be presented.

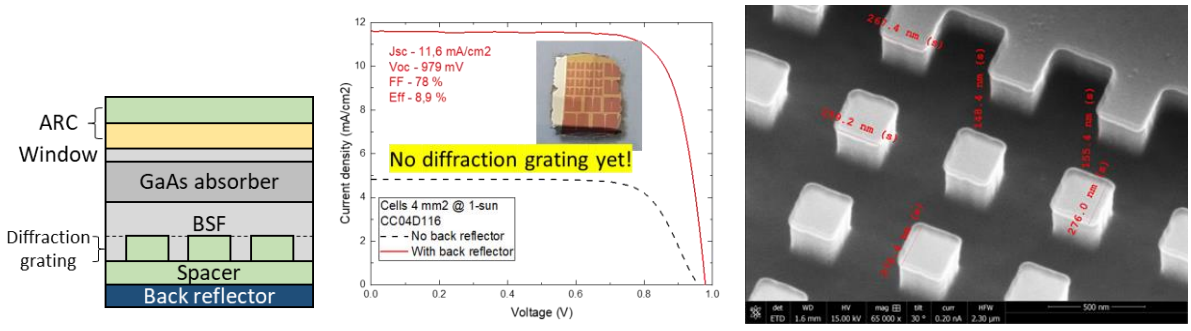

Figure: *(a) IV curves of inverted cells with and without a flat back side mirror. The inset shows a picture of the devices. (b) SEM image of a patterned diffraction grating on an AlGaAs layer.*

References:

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