Is solar going indoors?

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Recent developments in the field of photovoltaics and their prospective role in the internet of things (IoT) applications indicate a clear need to leverage on their ability to operate indoors. Low-light harvesters are particularly interesting, as they can provide a driving source for low-power sensor nodes used in various IoT systems [1,2]. In this work, we propose a facile, low-cost solar cell fabrication approach towards efficient indoor light harvesters based on graphene/n-Si Schottky-junction. The cells exhibit the efficiency of 6% and only 0.2% in indoor and outdoor conditions, respectively; demonstrating a 30 times increase in efficiency indoors [3]. With Raman spectroscopy and thermovision we validate the operational stability of such devices over a period of 48 months and identify critical structural points responsible for performance degradation during the ageing process [4]. The high efficiency under indoor light is caused by large shunt (parallel) and serial resistances. As we used high quality c-Si which is very stable over many years and graphene that becomes more stable with time, we can conclude that the Ag contact degradation mostly impacts the cell performance. The cells are produced from liquid phase exfoliated graphene made by Langmuir-Schaefer assembly [5]. In addition, cells were annealed (A cells) and then functionalized for 5 min by UV/ozone (AO cells). We found that AO cells exhibit a better performance than A cells even though they have a lower EQE. The main reason is the existence of a small Egap in AO. We assume that our cells are better in dark than light conditions because of intense recombination owing to the highly doped Si. Those cells have high concentrations of carriers leading to efficient photo conversion, but more light results in more carriers and a higher recombination rate, consequently reducing the efficiency of the cells. A good performance at low light intensities could significantly extend the usage of Si solar cells in indoor light conditions. Finally, the low cost solution production process of the graphene films will have an important impact on faster adoption of these devices.

REFERENCES

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FIGURES

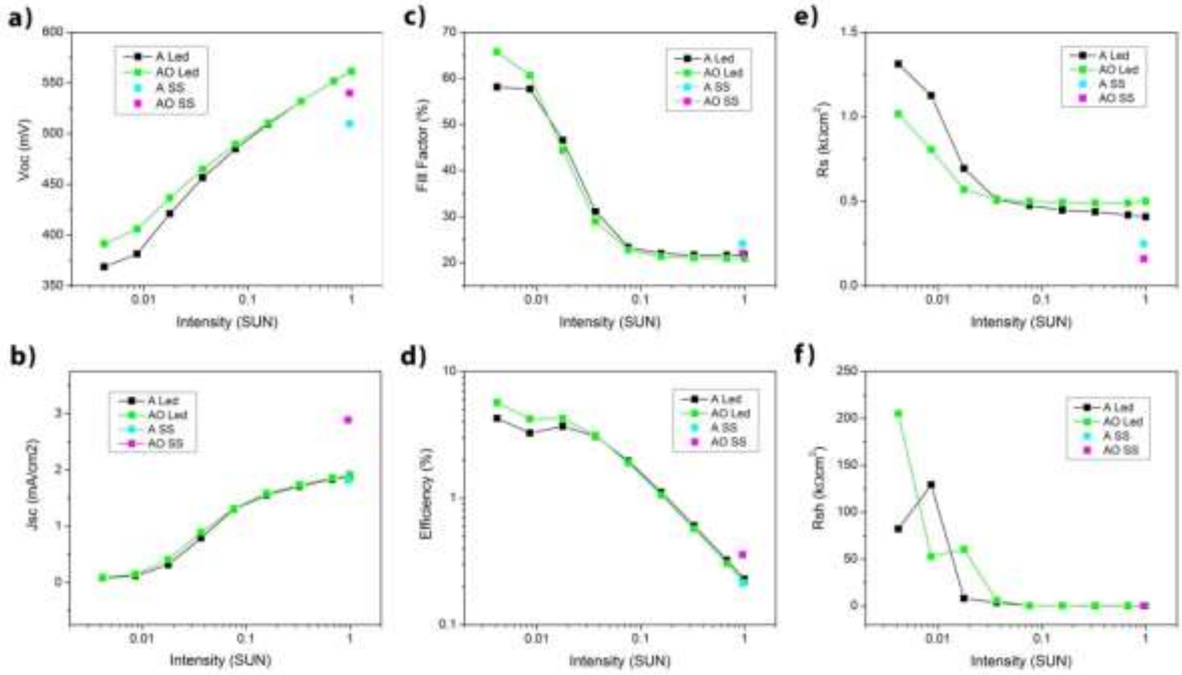

Figure 1: Solar cell parameters of pristine A and AO cells for different light intensities (indoor to outdoor) from LED (4200K, 0.004-1Sun) and Solar Simulator AM 1.5G (0.96Sun) light sources.