Solar cell woes

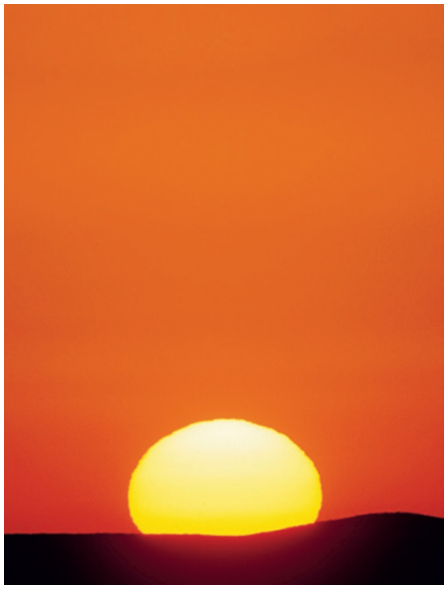
The pressure to publish results claiming organic solar cells with high efficiencies is leading to pervasive problems of false reporting within the community.

Widespread misreporting of power conversion efficiencies — a key metric for judging the performance of solar cells — is damaging the organic photovoltaics field and risks bringing it into disrepute. That's the damning conclusion of a new study performed by scientists from the University of Konstanz in Germany. Writing in a *Nature Photonics* Commentary (page 669), Lukas Schmidt-Mende and colleagues describe how they analysed 375 papers related to organic and organic–inorganic hybrid solar cells that were published in 13 journals during the period 2011–2012[1]. In each case, the team compared the claimed measured short-circuit current data (J_{SC}) of the cell with what could be reasonably expected from the cell's published external quantum efficiency (EQE). Shockingly, they found that in around one-third (37%) of cases a significant (>20%) discrepancy between the two existed, which draws serious doubts over the measurement techniques being used and the validity of efficiency claims that are being reported. In a number of cases, the discrepancies were larger than 100%. Furthermore, some of the papers reporting suspicious data have been highly cited and run the risk of becoming long-standing false benchmarks of performance.

This study is not the first to raise concerns over the integrity of organic solar cell characterization, but worryingly it does indicate that the problems are now endemic. In 2012, *Nature Photonics* published a Commentary by Henry Snaith from Oxford University describing how the problems of absent (or inadequate) masking and the use of non-standardized illumination can generate erroneous data when characterizing organic solar cells[2]. And more recently, hysteresis issues in the current–voltage scan measurements of perovskite cells (different current densities are measured when the voltage is scanned up and down) have been discovered[3]. This inorganic–organic hybrid material system has received much attention over the past couple of years due to the astonishingly rapid progress in performance improvements[4]. It is the subject of a focus in the September issue of *Nature Materials*, which also draws attention to the importance of reporting accurate and reliable data (*Nature Mater.* **13,** 837; 2014). The difficulties and challenges involved in characterizing nanostructured solar cells are also discussed in the September issue of *Nature Nanotechnology* (*Nature Nanotech.* **9,** 657; 2014).

So what needs to be done to address the situation? Fortunately, it seems that the adoption of a small number of simple steps could be highly effective in stamping out the publication of sloppy and dubious data. Several groups have now published guidelines on how organic cells should be characterized, describing the common pitfalls that need to be avoided[5,6]. As suggested by Lukas Schmidt-Mende and co-workers in their Commentary, it's most important that solar cell papers provide adequate description of the methodology used for characterizing the cells as well as all experimental details. This not only brings the benefit of much-needed transparency for readers but will also serve to increase the reproducibility of published work. In particular, confirmation that a mask was used for measurements and information about the mask's size, the illumination source, the number of cells measured and the variation in their performance is especially important. These are details that *Nature Photonics* will now be requesting from authors and checking to ensure is present prior to the publication of all solar cell papers that feature power conversion efficiency measurements. We will also be bringing these issues to the attention of reviewers and prompting them to raise any concerns that they have in their reports.

Furthermore, for cells claiming exceptionally high efficiencies that constitute a record for the field, it is especially critical that the data is robust, accurate and credible. For this reason we will be requesting that, wherever possible, the authors of such papers present measurement data that is accredited by an approved standards laboratory such as the National Renewable Energy Laboratory (NREL) in USA, the National Institute of Advanced Industrial Science and Technology (AIST) in Japan, the Fraunhofer Institute for Solar Energy Systems in Germany, or the services of the Newport corporation. Such accreditation not only brings complete confidence to the efficiency claims being reported, which is important to gain the trust of the community, but also means that they will be eligible for entry into official charts and tables that track the performance of solar cells[7,8].



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Widespread problems with the characterization of organic solar cells threaten to bring the field into disrepute.

We would, however, like to take the opportunity to make it explicitly clear that *Nature Photonics* is not only interested in high-efficiency solar cell papers that are reporting record performance values. Although such achievements can indeed represent important milestones for progress in the field and merit publication, papers that provide new insights into the photophysics and mechanisms of cell operation or describe new elegant and highly innovative designs are of considerable interest and are welcomed. ❐

References

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