西安宝莱特

对话 **Henry Snaith**

这位牛津大学的物理学家在全力推进钙钛矿太阳能电池产业化。

英国牛津大学的物理学教授 **Henry Snaith** 是钙钛矿太阳能技术的先驱。像甲胺碘基钙钛矿这类物质展示了非常卓越的将光能转化为电能的本领，这可能提供一种更廉价取代传统硅基太阳能电池的选择。美国《化工新闻》（**CEN**）自由撰稿人 **Mark Peplow** 最近逮到新当选英国皇家化学会 **Fellow** 的 **Snaith** 教授，探讨了钙钛矿太阳能电池的商业前景。

1. 为什么钙钛矿在光伏研究中引起如此大的轰动？

最早的有关钙钛矿太阳能电池的研究报道是 **2009** 年由日本科学家开始，自那以后，我们将其推高到 **20%**的光电转换效率，仅仅几年时间从无到有，现在的光电转换效率可以和最好的晶体光伏材料媲美。而且，钙钛矿太阳能电池制作过程也不复杂--你只需要从廉价的盐开始，将它们混合在一起。

钙钛矿太阳能电池似乎还可以达到更高的转换效率，直到 **30%**，因此它不仅是成本最低，而且还是效率最高的光伏技术。

2. 您准备如何推进钙钛矿电池市场化？

早在 **2010** 年我就自牛津大学分拆出一个公司叫 **Oxford Photovoltaics**。光伏产品要使用 **25** 年甚至更长，因此大多商业化努力是确保钙钛矿太阳能电池的所有膜层都能保持稳定，能承受极端的温度，光照和湿度，然后才能考虑将电池面积做大。

我们的先是要将钙钛矿电池直接做在硅基太阳能电池上，也许可以将产业化硅基太阳能电池效率自 **20%**提高到 **25%**或者更高。以这种方式，我们就可直接进入目前占据市场主导地位的硅基太阳能市场。我们的目标是在 **2017** 年建成首个电池试产线，最终，我们用全钙钛矿串联太阳能电池打败钙钛矿-硅基混合太阳能电池。

3. 您用什么方法来改善钙钛矿电池的性能？

电池性能会受许多因素的影响。在钙钛矿材料的结晶度问题上我们做了大量的工作，晶粒大小，晶粒界面的本质是什么状况，缺陷是否影响器件性能等。

我们发现钙钛矿膜层和两侧电极界面让我们损失很多的电压输出。因此，我们试着更换不同接触材料，包括二氧化钛，**C60** 以及半导体聚合物等。

我们也希望能够在 **150**℃以下处理所有膜层，这可以使我们在不需要加热和再次结晶的情况下，就可以将钙钛矿电池置于高效率的硅基太阳能电池之上。

4. 钙钛矿的含铅量会不会成为问题？

这些电池都会很好的密封起来，所以泄漏的风险是很小。我们必须对模块回收再利用，就像第一太阳能公司（位于美国亚利桑那州，坦佩）处理碲化镉太阳能电池一样，不会直接填埋起来。我们也致力于寻求无铅的选项作为备份。

5. 钙钛矿也对湿度敏感，您如何在实验室以外来测试他们的性能?

典型的硅基太阳能电池需要将器件暴露在相对湿度 **85%**，温度 **85**℃的条件下 **3000** 个小时，如果能这样，就会发现器件可以维持 **25** 年使用。现在，**1000** 小时的测试一切良好，我们正准备开始 **2000** 小时的实验了。

6. 您有没有担心过钙钛矿不会像所说那样有前途？

我不担心，因为我认为它会带来一些有用的东西。我们有能力去创造一个可以改变电力产业的技术。如果我们不试着去做，那一定是失败。如果做了但不成功，那也会是基本的物理问题或者材料性质有问题，不过我们会不遗余力让它成功。

Mark Peplow 是美国《化工新闻》（**CEN**）的自由撰稿人，《化工新闻》是美国化学会的新闻周刊，编辑因文章长度和清晰的原因略有删改。

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A Conversation with Henry Snaith

Mark Peplow

The Oxford physicist is racing to bring perovskite solar cells to market.

Henry Snaith, professor of physics at the University of Oxford, is at the forefront of developing photovoltaic devices made from a class of materials known as perovskites. Compounds such as methylammonium lead iodide demonstrate remarkable abilities to convert light into electricity, and could offer a much cheaper alternative to conventional silicon solar cells. Mark Peplow caught up with Snaith, recently elected as a fellow of the Royal Society, to discuss perovskite solar cells' commercial prospects.

Why are perovskites causing such a stir in photovoltaics research?

The first reports of perovskite solar cells came from Japan in 2009, and since then we've pushed them up toward 20% power conversion efficiency. So they went from nowhere to being competitive with the best crystalline photovoltaic materials in just a few years. They're also very easy to produce—you start from inexpensive salts and just mix them together.

Perovskites look like they should reach even higher efficiencies, up toward 30%. So they could be not just the lowest cost technology, but also the highest efficiency technology.

How are you trying to commercialize perovskite cells?

I spun out a company called Oxford Photovoltaics in 2010. A commercial product will have to last for 25 years or more, so a lot of the commercial effort goes into ensuring that all the layers of the solar cell are stable, and will withstand extremes of temperature, light, and humidity. Then we're moving on to scaling up the area of the cells.

Our first target is to put these perovskite cells directly on top of crystalline silicon solar cells in a tandem configuration, which could increase the 20% efficiency of a commercial silicon cell up to 25% or more. That way we get a direct entry into utility-scale silicon photovoltaics, which is the biggest photovoltaic market. Our aim is to get the first pilot line producing cells in 2017. Ultimately, it may be that we have an all-perovskite tandem cell that beats a perovskite–silicon cell.

What are you doing to improve the perovskites' performance?

A number of things affect the performance of the cells. We're doing a lot of work on the crystallinity of the material, how big the grains are, what the nature of the grain boundaries are, and whether there are defects that reduce the performance.

We're losing a lot of voltage at the interface between the perovskite and the electronic contacts that sandwich it. So we're trying different contact materials, including titanium dioxide, C_{60}, and semiconducting polymers.

We also want to be able to process all the layers below 150 °C, so that we can put a perovskite cell on top of high-efficiency silicon cells without having to heat it up and recrystallize it.

Is the lead content of perovskites a problem?

The cells are going to be very well encapsulated, so the risk of leakage is minimal. But we will have to recycle modules, just as First Solar [based in Tempe, Ariz.] does for their cadmium telluride solar cells. It wouldn't just go to landfill. We are also looking at lead-free alternatives as a backstop.

Perovskites are also moisture sensitive—how are you testing their ability to survive outside the laboratory?

The silicon photovoltaic industry typically exposes its devices to 85% relative humidity at 85 °C for 3,000 hours, and with

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that they're happy the stuff will last for 25 years. At the moment we're doing well on the 1,000 hour tests, and now we're getting ready for 2,000 hour tests.

Do you ever worry that perovskites won't live up to their promise?

It doesn't worry me, because I think something very useful will come out of it. We have the possibility to create a technology that could transform the power industry. If we didn't even try, *that* would be a failure. And if it doesn't work, it would be the basic physics or material properties that have failed. We will try our hardest to make it a success.

Mark Peplow is a freelance contributor to Chemical & Engineering News, the weekly newsmagazine of the American Chemical Society, Center Stage interviews are edited for length and clarity.

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