Harry Tuller, 2. August 2013

Podcast Manuskript

Vorspann Deutsch:

Prof. Dr. Harry L. Tuller forscht am Massachusetts Institute of Technology, USA, an neuen Lösungen für die Umwandlung und Speicherung erneuerbarer Energien. Der international bekannte Experte war im Sommer 2013 für mehrere Wochen am Helmholtz-Zentrum Berlin zu Gast, um mit der Gruppe von Prof. Dr. Roel van de Krol am HZB-Institut für Solare Brennstoffe zusammen zu arbeiten. Ermöglicht wurde dieser Gastaufenthalt durch einen Helmholtz International Fellow Award. Wir haben Professor Tuller gefragt, warum er gerade das HZB besucht, wie er die Aussichten einschätzt, dass wir die Solarenergie irgendwann preiswert und effizient speichern können und was ihn dazu bewegt, auch jenseits der offiziellen Altersgrenze weiter zu arbeiten. Seine Antworten sind so interessant, dass wir das Interview in voller Länge zum Hören und Lesen anbieten.

Teaser Englisch:

In summer 2013, Professor Harry Tuller was visiting the HZB for several weeks. His visit was sponsored by a Helmholtz International Fellowship Award. Tuller is an expert in the field of fuel cells, batteries and new solutions for energy transformation at the world famous Massachusetts Institute of Technology, USA. I could ask him some questions, starting with: Why did you choose to visit the Helmholtz Zentrum Berlin? We spoke as well about his motivation to continue his research after the official age of retirement, his perception of an increased interest in energy research in young people and his hopes for the future. His answers are so interesting that we offer the full interview, either as podcast or as a transcript.

Start: Tuller is an expert in the field of fuel cells, batteries and new solutions for energy transformation at the world famous MIT. I could ask him some questions, starting with: Why did you choose to visit the Helmholtz Zentrum Berlin?

00:14

Tuller: One of my areas of interest is the field of energy conversion, especially renewable energy. And at this institute there is now a highly regarded group working on solar fuels. I actually have known the head of this group, Professor van de Krol for some time, initially from the time when he was visiting with me at MIT as a postdoctoral researcher. We reconnected and continued discussions when he returned to Delft, and in the last year or so, we discovered a strong common interest in this area of photo assisted generation of fuels, for example by the splitting of water. So this visit to the Helmholtz Institute was the perfect opportunity to reconnect and follow through on some of the ideas we were thinking about.

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Prof van de Krol is now starting a new institute: do you have some good ideas for him?

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Tuller: Well, that's something he was also aware of and why he was pleased to have me come here. In order to make real progress in this field, we have to examine novel materials, which can be fairly complex. To date, much work in this field has been on the basis of trial and error, and we both believe it is an opportune time now to delve into these materials in a deeper fashion in order to really understand what are the processes that limit the efficiency and stability of these materials. A key area in which I have a good deal of expertise, is in understanding, evaluating and describing the defect structure of these materials. So, already from the preliminary work that we have been able to do so far, we are excited about the trends that we are seeing, and we are convinced that this will end up providing very interesting and attractive results.

03:12

Your devices are very small. What are the chances to make them big?

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Tuller: Many people have fallen in love with the material which we are now focusing on - hematite, which is only iron-oxide or rust. It is inexpensive, available in large amounts in the earth crust, and nontoxic. So the potential, the cost, the fabrication and the ability to make large areas are enormous. However, progress has been slow in the last several years. So efficiencies of 4-5 % have now been demonstrated, but if that number can be doubled or tripled, this becomes really exciting.

04:25

Is there a possibility with rust or metal oxide and solar cells to make this dream come true that every family can have a system on their roof which is either harvesting sunlight and convert it into electricity or into fuel? Do you think that this is realistic?

04:51

Tuller: A good way to look at this is to consider, what was the situation in solar cell photovoltaic (PV) technology fifteen or twenty years ago. At the time, the cost per watt was viewed as about 100 times of what it needed to be. So if one looks at the situation at that point and said stop, no point in doing further research, it is unrealistic, we would never be in the situation, we are today. Fifteen or twenty years later, with continued investments, improvements and developments, we have reached the point when solar cells are competitive – at least in some locations – with the conventional means in generating electricity by the burning of fossil fuels.

So, my point is that the technology which converts solar radiation directly into fuel is already at a much higher level than PV was at that point. We do not have to improve things by two orders of magnitude but maybe let's say by one order of magnitude. I would say there is a great deal of promise and I would argue that within a decade, sufficient progress will have been made to demonstrate the feasibility of these cells from a practical perspective.

06:39

What is the next big challenge?

Tuller: It depends how you define your challenge. The holy grail would be to find a single material to do the complete function: to absorb the solar energy and convert that into hydrogen gas. That requires that one single material satisfy many criteria simultaneously: optical absorption, electrical transport, stability within the liquid environment and its catalytic activity. We can find materials with two or three of these properties but It is hard to get all four together.

So I think the biggest challenge is to find a single material which satisfies all those criteria and there are different approaches that people are taking. I personally am optimistic and I think as a scientist you have to be optimistic, otherwise you should be in another field. But actually one can visualize much more rapid progress by going to hybrid devices and composite systems: so right now for example, there are compound cells in which one part does the chemistry well, coupled with more conventional solar cells which efficiently generate the voltage or driving force.

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Do you think that we will see another breakthrough or do we need just do drill a bit deeper? Revolution or evolution?

09:58

Tuller: We ask ourselves this all the time. We all would love to see a breakthrough, but we should not depend on that. The problem is huge and the planet is under a great deal of stress: We have to move in many parallel directions to make progress, whether it is evolutionary or revolutionary. The point is: What are the chances to get a revolutionary change? I think, if you put enough people on these issues, unexpected things can happen; the more resources and people from different disciplines are involved addressing the problem, the more likely it is that it generates some kind of synergy and surprising connections.

So I think that we are exciting a lot of young minds, the bright young people are coming back to science, because they want to do something about the planet's safety.

12:07

Is it so? Do you experience that young people come back?

Tuller: We are seeing a recovery of interest in sciences and engineering, and I think it is clear: people go where they hope to have an important impact. -- If you give bright young people a challenge, which they think is important to deal with, they will flock to that area. And we are seeing a huge increase in applications at my institute MIT, and on the application forms, the students write, I want to come and work with you in your department, because I am interested in addressing the environmental and the energy problems.

13:07

That's wonderful news. I would love to ask you a personal question. You mentioned in your talk: Scientists do never retire. Why is that so? Why are scientists so keen on continuing working?

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Tuller: Well, there are two reasons, one is: It is an area where you can continue to be stimulated and excited about new ideas. It is not a question just of age - In many fields, once you are familiar with a field, it becomes quite routine, but the thing which is exciting about science is, that it is all the time evolving. And we try to solve real problems; there are still plenty of challenges. And particularly for me, being at the university and interacting with people in institutes like this, is: you are automatically thrown in with young people and some of their excitement of seeing something new is reflected back onto you…you come in, you discuss things, you see other people excited, it is a self-sustaining kind of process.

In the US, we are fortunate that by law there no longer is an official retirement age, so if someone is able and desires to continue working, he or she can do so. I continue to enjoy the stimulation, it keeps me going.

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You also will give these young people something, I guess. What do you consider are abilities which get better with experience or age? Do you think there are something which you can do now better than thirty years ago?

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Tuller: Well, for sure, the point is: you would like to believe that an individual is a kind of tree. You start with certain roots and continue to branch out with time and each branch itself can branch. So with time and experience you have had the opportunity to investigate and become aware of and interact with different concepts. And now, if you have a new problem at hand, you have that wealth of experience, not only knowledge about things, but also how to approach a problem, different techniques. It is that kind of experience which can help a younger person in navigating how to approach their own career. They do not have to make all the mistakes on their own. Besides helping students, I am also very interested in helping younger colleagues in developing their careers, in terms of advising them about their science and their teaching, making that more efficient for them and seeing them succeed.

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What result would you really love to see next decade?

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Tuller: Well, obviously I have had a long interest in environmental and energy issues. And right now the trend is looking not so positive. The rate of improvement in our ability to minimize the use of fossil fuels and integrate new technologies doesn't seem to be keeping pace with the growth of demand of energy. So what I would love to see from a worldwide standpoint, is that we finally do reach that peak where our energy demands no longer continue to grow and that these promising technologies, which we have been working on for so many decades, finally enter the market place and start having an impact.