With a doctorate in physical chemistry from the University of Oslo, Alf Bjørseth was an associate professor at two Norwegian universities before moving to contract research organizations in Norway and the United States, and then to Norsk Hydro and Elkem in Norway. In 1994, he set up ScanWafer, which produced multi-crystalline silicon wafers, and four other solar industry companies before merging these into REC—Renewable Energy Company. When REC went public, Bjørseth sold his shares and recycled the proceeds, through Scatec, in new companies working with the latest technologies in renewable energy and advanced materials. For Scatec, climate-neutral energy means solar power, offshore wind power, and thorium instead of uranium for power generation. “Materials is a foundation for almost everything we do in our company,” Bjørseth said, adding that Scatec group companies focus on titanium, carbon nanotubes, and rare earths. As a scientist, Bjørseth added, “The more I learned about technology, the more opportunities I saw and the stronger was my desire to take one of these opportunities and create something. That has been my driving force, my passion.”

**MRS BULLETIN:** What is Scatec’s investment philosophy?

**ALF BJØRSETH:** Our job is to create value and to make the world a little cleaner; that’s our vision. We focus on projects in renewable energy and advanced materials.

Within this framework, we have to seek a significant market for innovations. We do this by looking at “macro trends,” that is, where the market is going. We also want to see significant technology improvements in our projects. So advanced technology and growing markets are the combination that we believe in.

We are focusing on two macro trends today. One is climate-neutral energy, which does not emit CO₂, and we are convinced it will continue to grow for the next 50 years. In addition, we think that materials will play a very important role in this century, and we are focusing on three kinds—titanium, carbon nanotubes, and rare earths.

**How do you decide on new materials and new technologies?**

We start by looking at broader trends, “macro trends,” because we need to see a market. That is the most important thing.

Sometimes we are so fascinated by technology that we think we have the solution and then we look for a problem, a much more expensive and time-consuming process.

When we started with solar energy in 1994, it was a very small market. But we had a very strong feeling that this would grow—it’s obvious, the sun is free, it’s available for everybody, and we can generate energy every place. At that time it was expensive, but today we compete with conventional energy sources in most areas.

**What research challenges do you see in photovoltaics (PV)?**

The workhorse for solar energy today is based on silicon because it’s an abundant material and has very good effects. But the biggest challenge is to find ways of increasing the efficiency of silicon-based solar cells. Everybody is working with cost reductions in all the parts of the production chain, but the effect of increased efficiency influences the cost of the total value chain, including installation. The more efficient a solar module is, the less area we need to cover to produce the same amount of energy.

The first step, of course, is to use n-type instead of p-type wafers, and then we are looking at ways to increase efficiency by monocrystalline, high-efficiency, advanced cell production, and then come multi-junction cells. And then hopefully sometime in the future, we will add very specific elements such as plasmons.

When we analyze the value chain of producing cells, modules, and wafers, one of the most waste-creating steps is to use a wire saw. To reduce
the waste, it’s better to start with a
gas instead of polysilicon and then
make the wafer directly. For instance,
epitaxial growth is a way of doing that.
You need substrates, but if we can
reuse the substrate up to, let’s say, 100
times, the price of the substrate is not
so important.
This kind of crystalline thin-film
uses very little high-quality material.
And if we cut the cost of crystalline
silicon another 50%, and we increase
the efficiency, it will be extremely
difficult to find alternatives to crystalline
silicon.

What is the role of materials in gener-
al, whether new materials or existing
ones?
In materials, our biggest effort is in
new methods to produce titanium com-
ponents. Titanium is an extremely in-
teresting metal that is hampered by the
difficulties in producing components. It
requires a lot of machining, and there’s
a lot of waste of material, which results
in very expensive components. We have
developed what we call “a near-
net shape” production technology for
making titanium components that re-
duces production costs approximately
50%, which is of significant interest to
a number of industries.

Titanium is corrosion-resistant to
sea water, so we see applications in the
offshore oil and gas industry—a very,
very important market. Even more
important are applications in the aero-
space industry. That requires a lot of
qualifications. We are almost through
the qualification procedures now, and
we will be ready in 2013 to start sup-
plying to that industry.

With n-Tec, we have a very good
process for making multiwalled carbon
nanotubes (CNTs) with “arc technol-
ygy.” In Norway, we have cheap
hydroelectric power, so we can use
electric arc technology to produce
CNTs; very strong particles. We don’t
use any catalysts and so on, so it’s a
very pure material. This is one of the
few examples in our portfolio where
we are still looking for the problem.
How do we use the strongest fiber
known, which is this multiwalled CNT,
in the best possible way? We have
certain applications now as additives
to composite materials, making them
electrically conducting or insulating.
We are now trying to add them to met-
als, which could be extremely interest-
ing; metal CNT composite materials
have not been made before, but we are
looking at that right now. Mixing CNT
and titanium could be very interesting.

We work with rare-earth elements.
We see surprising effect for some of
these elements in combination with
other materials for electronics, for bat-
teries, for magnets.

We work with mining companies—
in Australia, the United States, and
South Africa—with a side stream of
rare-earth elements; they are actually
byproducts. Rare-earth elements are a
mixture of 17 different elements. You
need quite a bit of advanced tech-
nology to separate and purify these
elements. Developing these technolo-
gies is also a big challenge. There have
been technologies that are quite pol-
luting and use a lot of solvents and so
on, and we want to find metals that are
environmentally much more sustain-
able. We are working with universities
and research organizations to actually
develop these technologies. We are
coooperating with the University of
Lund, and we are going to set up the
first small plant producing rare-earth
elements in Norway in 2013.

How can you foresee future criticality
of elements?
That’s also a very, very important as-
pect because, when we see that we are
really making an impact on the global
resources of a certain element, we need
to consider other suitable alternatives.
For instance, for conventional silicon-
based technology, we use silver, and
silver is actually going up in price
because we use too much of the mate-
rial. We have, for CIGS, the question
of limited availability of indium, and
for cadmium telluride, there’s also a
question of how large can that industry
become. And most likely both these
technologies will be limited for avail-
ability of materials compared to what
we can do with silicon.

In order for PV to grow really big it
has to be based on abundant materials
such as silicon. Furthermore, Si-based
technologies have a large potential
for significant cost reductions and to
provide solutions with high efficiency
and low cost. This will make silicon the
prevailing alternative for solar energy. □
Typical fields of study:
Solar cells—a:Si, CIGS, CdTe
Organic electronics—OTFTs, OLEDs
Transparent conducting oxides—ITO, ZnO, IGZO
Semiconductors—GaAs, GaN, SiGe, HgCdTe, SiC

Now you can characterize novel low mobility electronic materials — down to 0.001 cm²/Vs!

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