SIXTH ASIAN CONFERENCE ON ELECTROCHEMICAL POWER SOURCES

Dr. S. Sivaram
CSIR Bhatnagar Fellow
A 201, Polymers and Advanced Materials Laboratory
National Chemical laboratory
Pune 411008 India
Email: s.sivaram@ncl.res.in

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Professor Shukla, Chairman, ACEPS-6, Dr. Gopukumar, Co- Chairman, ACEPS-6, Mr Vijayanand, Professor Ogumi, Dr Vijayamohanan, Dr Shivashanmugam, our distinguished friends from overseas, delegates to the Conference, ladies and gentlemen,

It is indeed a great pleasure and privilege for me to be amongst all of you today, at the inauguration of the Sixth Asian Conference on Electrochemical Power Sources. On behalf of the organizers of this Conference I extend to all of you a warm welcome to this historic city of Chennai and hope that your stay here is both enjoyable and productive.

Electrochemical power sources have emerged as the key enabling technology for the twenty fist century. Availability of clean and carbon neutral energy generation depends critically on advances in electrochemistry and material science. Wide spread applications of renewable energy as well as replacement or reduction in the use of fossil fuels in transportation will need new solutions which only electrochemistry can provide. It is only, therefore, fitting that this Conference focuses on three main topics, namely, charge storage, supercapacitors and fuel cells. Advanced battery systems, supercapacitors and electrochemical energy generation, together hold great promise for the future well being of humankind.

Clean and abundant source of energy is one of the key concerns of our times. It is clear that the world cannot continue to burn fossil fuels for energy without causing long term damage to our planet. The emerging economies of the world, such as China and India, have large needs for energy to sustain their economic growth and lift vast sections of their population out of poverty in one generation. Solutions that have stood the test of time in the last century in more developed part of the world require critical reexamination in the context of the energy needs of economies of countries in Asia, Africa and Latin America.

What then will be major drivers of technology in this area?

Transportation indeed is the major focus of electrochemical power sources. The focus is on cars and companies around the world are developing all electric or plug-in hybrids capable of running on batteries for short distances. At the heart of this development is the ability to build superior rechargeable Lithium ion batteries, so ubiquitous now in small devices such as mobile phones, laptops and other hand held devices. Since personal transportation is a major concern of the developed world, more money is being spent on Lithium ion batteries than all other battery chemistry combined. Still the success of Lithium ion battery in automobiles is not assured. Its biggest weakness is its tendency to become unstable if

overheated, overcharged or punctured. The recent incidence of fire in GM's plug in hybrid Chevy Volt has only accentuated the limitations of battery technology. Volt is powered by a doped iron phosphate based technology which emerged from MIT in 2002 and being developed by A123 Systems, a company founded by Professor Chiang.

Although, traditionally Japan has been in the forefront of technology in the area of automotive batteries, there has been increasing investments in the US in the last three years. This is fuelled by President Obama's call to put one million plug in hybrids on the road by 2015 and DoE's goal of a plug in battery that can travel 70 kilometers or more on electricity alone. A slew of funding opportunities have been created by the US government for companies engaged in development and manufacturing of batteries for transportation applications. Buoyed by Government funding, Venture Capital money has also flown into ventures dealing with batteries to the tune of over US$ 200 million in 2010.

In spite of all this heightened interest in Lithium ion batteries, its future in transportation is still not assured. Safety concerns, cost and availability of lithium and the complexities of its separation from either ores or brine, pose formidable challenges. Although inferior in performance today, zinc – air and nickel – zinc batteries, could be better alternatives in the long run. An independent entrepreneur in France, Mr Vincent Bollore has invested heavily into the development of Lithium- polymer gel electrolyte batteries which he claims are much safer. However, it requires higher temperature to function. Another question that remains unanswered is whether a single battery can provide both short bursts of power and steady power at cruising speeds. Sodium – metal halide based battery, which has been used in locomotives, could offer a potential solution for producing steady power.

One of the risks of Government intervention in specific technologies is that alternatives tend to be ignored since funding is directed towards "preferred" technologies. Technology evolves through multiple iterations and we must be cautious in believing too much in the predictions of pundits. Additionally in sectors, such as, transportation technology gets locked in for centuries. Once the choices are made, technology shift is not easy. So choices must be left to free market forces driven by true costs coupled with efficiency and long term sustainability.

The Indian transportation sector has its distinct challenges. The diversity of vehicle, their use patterns and road conditions are unique and not found anywhere else in the world. In the short term focus must be on smaller vehicles, including two and three wheelers. We must be able to retrofit an IC engine with a hybrid kit. China has taken the lead in all electric two wheelers, which are now being introduced in India. These are based on Lithium – Cobalt batteries. There is an opportunity to find a lower cost alternative. On the other end of the spectrum, there must be focus on hybrid heavy vehicles. Issues such as weight are not relevant, but the user needs are very different.

Capture and storage of small transient power will become increasingly relevant in the future. A number of human actions involve kinetic or mechanical energy, which can be efficiently converted and stored as electrical energy. Actions like walking water moving through pipes, or just typing on a key board generate sufficient energy to power small devices. For example, walking generates 60 to 65 watts of energy. Harvesting such energy will need integrated microscale energy scavenging systems (MESS), which will capture such small transient energy, amplify and store them in portable devices. Such solutions have great

relevance to India, where most people are not effectively wired to a socket for their electrical energy. Much of human activities occur on the streets or common places where plug in electricity is hard to find. Low cost but efficient supercapacitors, fast charging batteries coupled with piezoelectric or phase change materials will become very important in the years to come.

Lastly, effective and efficient deployment of renewable sources of energy will require robust battery systems. Very often, such energy harvesting farms are located in remote and less accessible locations. Long life, maintenance free and low cost batteries are necessary for such applications. Redox flow batteries are being considered the most appropriate solutions for this application. They are modular, have a rapid response, low maintenance cost and low environmental impact and hence very suitable for stationary storage applications. Vanadium Redox, Zinc Bromine, polysulfide Bromide and Cerium Zinc based flow batteries have been demonstrated in several power systems applications. They have very long life (15-30 years) and can withstand long duration applications with 250 + cycles per year.

Friends, Opportunities are many in the area of electrochemical power sources. Solutions have to be tailored to every geography for it to be effective. Whereas, knowledge is available across the world, its specific adaptation to problems needs customization. This is India's challenge – to probe the depths of new science, to understand the scope and limitations of available science, and integrate the unknown with the known, thereby, creating new applications which will serve vast numbers of our people.

Conferences such as this provide great opportunities for the confluence of minds from different parts of the world. I hope out of these interactions will emerge a clear appreciation of what India needs in terms of science, technology and its applications. If this can be accomplished, I would deem this meeting as a great success.

With these words I formally inaugurate the sixth Asian Conference on Electrochemical Power Sources.