SAND AND AIR FOR SUSTAINABLE ENERGY FUTURE

Mark Anthony M. Lavapiez

Batteries provide a source of stored chemical energy, which is used to power many conveniences of our 21st century lifestyle – from clock and watches, mobile phones and laptop computers, heart monitors, hearing aids, cars, etc. Chemical energy is stored in molecules and is released as electrical energy when particular chemical reaction takes place. In addition, batteries also have an important role in creating a sustainable future, particularly in capturing renewable energy and power our energy intensive lifestyle. In producing these batteries, it is very important to consider the accompanying environmental consequences, since a battery that requires toxic materials and a lot of energy to produce is potentially not a sustainable option! With these considerations, it is good to ask questions like:

1.) How can we use safe materials that are plentiful (renewable) to make a battery that meets our needs?
2.) How can we develop a 'low energy' process to make a battery?
3.) How can we ensure that the battery components can be easily recycled into new batteries?
4.) How can we ensure the battery has a long life?

There are significant researches around the world to find more environmentally friendly solutions to battery design, where manufacture and disposal impacts on the environment are minimized or possibly eliminated. Development of new materials and technology for portable power sources is also a challenge being considered today, reducing the size of the power source and at the same time increasing its energy density. Oneof these innovations is considered in here: ***metal-air battery*** (particularly Silicon-air battery).

Metal-air batteries have attracted the electrochemistry research in the past years mainly because of its principle that the cathodic reaction is a catalyzed reduction of oxygen consumed from the environment, rather than stored in the system. This results in high energy densities and high specific energies of the metal-air batteries. Most of metal-air batteries including Zn-air, Al-air, Fe-air and Li-air utilize aqueous alkaline solutions, mainly KOH, due to the high conductivity of such electrolyte and its excellent ability to regulate the reduced oxygen ion into hydroxide ion. The Li-air presents the highest theoretical specific energy (11,246 W h kg^{-1}). However, Li is subject to corrosion in alkaline electrolytes and safety concerns are still unresolved for aqueous systems. Thus, a search for new metal-air batteries is of growing interest.

Recently, a silicon-based metal-air battery has been constructed. Thermodynamically, silicon exhibits attractive characteristics as an anode in metal-air batteries. Silicon is the second most abundant element in the earth's crust and usually found in sand in the form of silica. It is air battery with the unique structure of [Si wafer|EMI·$(HF)_{2.3}F$|air] will be discussed. This battery system has an undetectable self-discharge rate and high tolerance to the environment (extreme moisture/dry conditions). Such a battery yields an effectively infinite shelf life with an average working voltage of 1–1.2 V. Silicon–air battery can