

How is it that SMD Cells do what they do!

By M.J.Nunnerley 2010

Part 1. original concept lab notes

How is it that SMD cells do what they do! Here I will try to explain to the best of my ability the inner workings within the cell.

The first item to consider is the chemical reaction of oxygen with iron ($\text{Fe} + \text{O}_2$). This is an exothermic reaction, and therefore more energy is released when the bonds of Fe and O_2 are formed than it takes to break the bonds of the reactants.

$4\text{Fe} + 3\text{O}_2 = 2\text{Fe}_2\text{O}_3$ -1652KJ (the - sign shows it gave off this energy) "hematite".

There are many oxides of iron, and here we also need to take into consideration Fe_3O_4 it's common name being magnetite, black brown in colour and magnetic as opposed to hematite which is your common red brown rust.

Here is a theoretical example of the energy that can be collected with the reaction to hematite, in SMD reactions when higher oxidation states seem to form.

(55.8g of Fe = 1 mole)

(22.4ltrs of an ideal gas = 1 mole)

The above equation for hematite is 4 moles Fe + 3 moles O_2 = 1652KJ of energy.

From this we can calculate that 1gram of Fe reacted with 300ml of O_2 will give us 2watts of electrical power and 600ml of H_2 .

Consideration must be taken that we do not have an ideal gas which is diatomic O_2 , but monoatomic O in the exact moment of reaction with the Fe, and secondly we have a moment when hydrogen is present after the primary reaction has taken place. This sharp transition at the Fe electrode, is one of the reasons we see some unexplained results, and in the future the need to look into the reaction at a more atomic level. The iron electrode not only has a change of power direction, but also of power source and can be seen as a power spike on an oscilloscope, and what is collected by the power store to maintain it's charge. It has been noted a large magnetic moment at the iron electrode, and further investigation is needed here, beyond the fact that magnetite is one of the oxides being formed. The idea of extracting energy from the magnetic pulses just might be a possibility in future experiments.

This energy of reaction is normally given off as heat, but here we have created collection grids to extract this energy in the form of electron movement between the two grids (oxidation and reduction reaction), this is how a hydrogen fuel cell works when hydrogen and oxygen are reacted together to form water, a potential difference between electrodes and heat. The heat in this case is a non desirable effect, it is wasted energy reducing the efficiency of the cell. The heat in the SMD cell is very localised at the Fe electrode surface, and aids in the oxidation of that electrode thereby creating further electron exchange.

Now comes the complicated part, there are two electrodes, the hydrogen producing electrode and the iron electrode, each with isolated electron collector grids, the positive electrode we will look at later, lets look at the hydrogen electrode and it's collector grid first. Hydrogen is produced at the electrode by normal electrolysis along with the iron electrode and powered by either a high amp super cap bank or rechargeable battery with a paralleled capacitor to absorb the inrush of electron movement. This power supply is infact the main driving force of the system (60%), and is in a state

of charge and discharge all the time (in practice it is held to an equilibrium level of charge/discharge). The hydrogen that evolves from the hydrogen electrode, passes over the electron collector grid and so forming what is called, a **hydrogen electrode**, out of that grid, for all intent and purposse we can call this a 0v electrode. In practise this is probably not 0v, but in science it is given 0v as in reference to another electrode, in our case the iron electron **grid collector**. This electron grid collector has ion oxides passing through and has it's own electrode potential "x", (this works similar to a hydrogen fuel cell). As the two grids are connected together via an energy store, the potential difference charges this store (it becomes the load). It is this store that supplies the input current to start with via a booster circuit to the positive electrode and the iron electrode in the first half cycle of around 40% duty.

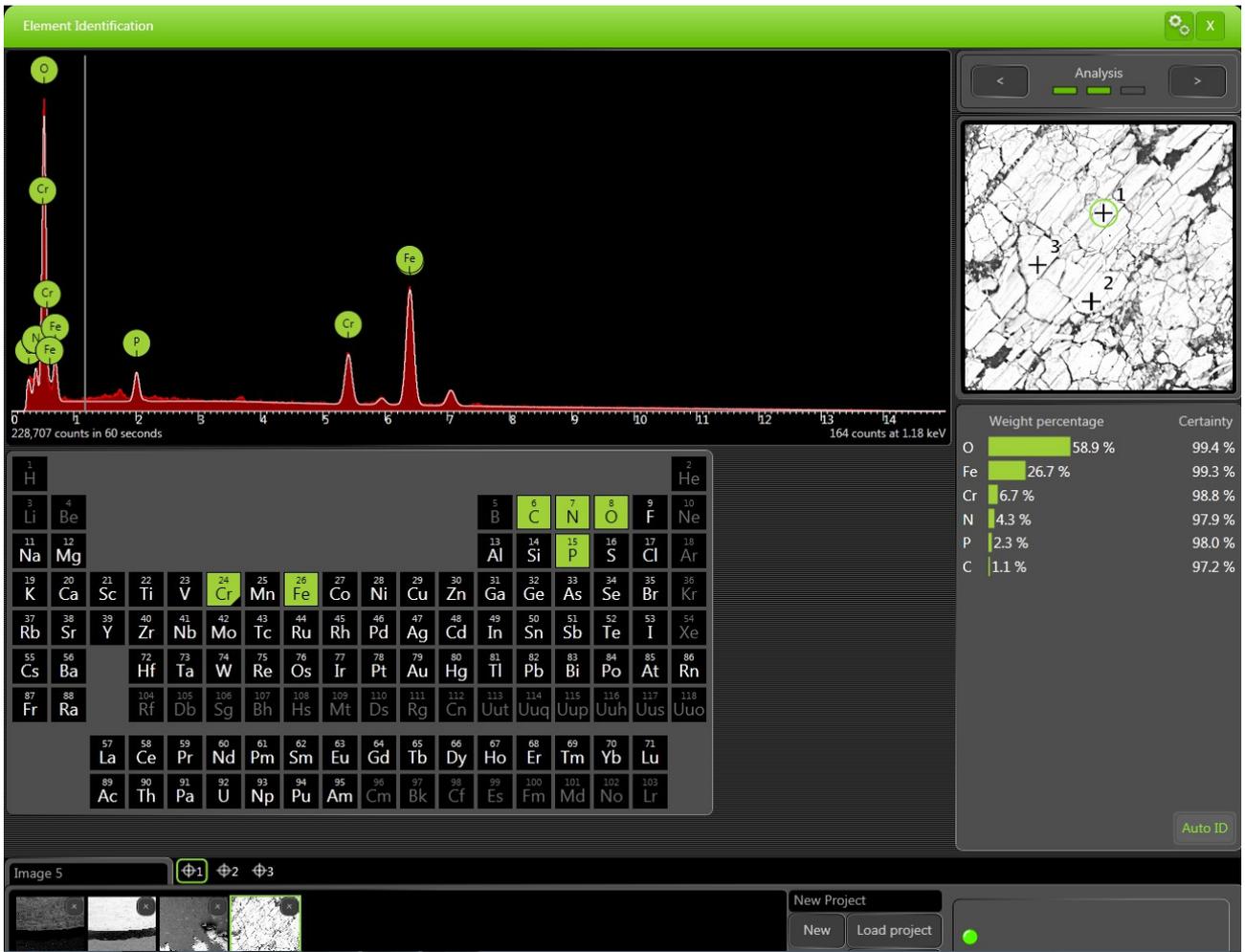
The effect of all this, seen by experiment, is that further hydrogen is released at the hydrogen electrode as the iron electrode goes to a higher and higher oxidation state. What is not known at this time is the complete complex reaction at the iron electrode when hydrogen is also produced at the 40% on duty, and then later oxygen at the 60% duty, the latter being driven from the power store between the iron electrode and the hydrogen electrode (two distinct power sources). The one thing that is known, is that if the duty of 40% was increased, the store will over charge. It is also known that if a battery is used for the store, it charges extremely fast and is a hard charge, and why when using a battery, a capacitor of high value (4700uf) and current rating should be placed in parallel with it to avoid over heating.

The Positive electrode in the cell is basicly always positive when in circuit (40% duty) but produces very little oxygen. When out of circuit it gains a negative charge, as so, it counters the oxygen produced by the reforming with hydrogen to form water again. One complete cycle is around 2-3sec and is adjusted along with duty cycle, to suit each cell design.

Video link with 3 stainless steel 316 electrodes, basic SMD, electrolyte sodium acetate in deionised water, the black looking electrode is the change over electrode where oxides are produced.
<https://www.youtube.com/watch?v=5Pxm4eVDc2s>

SEM results of the oxide on the electrode, no added CO2 to electrolyte.





Below the stripped electrode, this “was” smooth like the end section.

