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The nanotube solar panel is the most promising nanotechnology to replace the industry technology in the storage and use of energy, while EDLC is the second most promising and the paintable battery has very little chance of delivering any results in the near future. All of the \( V_{nanotechnology} \) are significantly less than one, showing that the value of carbon nanotechnology compared to the value of other technologies in the storage and use of energy is very low.

**Conclusion and Insight**

This analysis of the state of nanotechnology in the energy industry has many applications. First, it can help determine the money and time that should be allocated to each of these nanotechnologies. The Nanotechnology in energy storage in 2007 was estimated to be a US$3.7 billion market by 2011, while nanotechnology in energy creation in 2007 was estimated to be US$1.2 billion by 2011 (Shapira & Youtie, 2012). Since solar panels have the most likelihood of becoming a viable product, long-term investors or large organizations in these large markets might have a higher chance of return if they invest in this product. Particularly because a cheap, viable alternative to the current expensive solar panels is needed and because effective solar panels can also help solve a lot of the world’s problems in energy use and greenhouse gas pollution. However, if the investors are not in either of these markets, it is recommended that they consider other options for investing apart from these technologies since the value that the three considered provide to society is significantly lower than the technologies already available. To make these nanotechnologies more valuable to society, the EDLC needs to be cheaper, the solar panels need to be more efficient and the paintable batteries need to be cheaper. The main reason the nanotechnologies are so expensive is because the cost of carbon nanotubes is so high compared to common materials used in the non-nanotube technology. While the price of carbon nanotubes is expected to decrease to US$50 by 2020 (Van Noorden, 2011), this is still relatively high. Perhaps more research should be done into cheaper alternatives to carbon nanotubes, or cheaper ways to manufacture them. The efficiency of the solar panels could be improved by more research into different kinds of carbon nanotubes, ones that have slightly different shapes and properties. For example, research into carbon nanotubes that are produced from the arc-discharge method is expected to increase its efficiency from 0.46% to 1%. (Ramuz & Co., 2012). Carbon nanotechnologies could potentially have more impact on the world, and particularly in the energy sector, if these steps are taken.

**References**


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**HIGH TEMPERATURE ELECTROLYSIS ON LA\textsubscript{0.6}Sr\textsubscript{0.4}FeO\textsubscript{3-δ} MODEL-TYPE THIN FILM CATHODES**

In order to ensure sustainable energy supply, extending the use of renewable energy carriers is a key issue in today’s energy resources management. Since the output of alternative power sources such as wind or solar energy varies strongly, an effective conversion of electrical energy into a storable form (e.g. chemical energy) is highly important. Solid oxide electrolysis cells (SOECs) that operate at high temperature (600-800°C) have the fundamental advantage of being able to reach higher efficiency than electrolysis at lower temperature. SOECs can convert \( H_2O \) to \( H_2 \) but also the production of \( CO \) by electrolysis of \( CO_2 \) or even co-electrolysis of \( H_2O \) and \( CO_2 \) (giving synthesis gas that could be used for Fischer-Tropsch processes) are conceivable. Most current studies on SOECs use solid oxide fuel cells (SOFCs) in reverse mode. However, the "standard" hydrogen electrode material, a porous Ni/YSZ cermet, has shown several disadvantages in electrolysis mode such as stronger degradation and lower activity for \( H_2O \) reduction than for \( H_2 \) oxidation [1-3]. Acceptor-doped perovskite-type compounds show
electronic as well as ionic conductivity which makes them promising candidates for new SOEC electrode materials. Electrolysis on well-defined model-type thin film electrodes with simultaneous quantification of the electrolysis product offers a powerful method for assessing a material’s activity for hydrolysis because the voltage drop at the working electrode (i.e. the energy input) can be related to the amount of product produced.

In this work, electrolysis of water was carried out on a La_{0.6}Sr_{0.4}O_{3-δ} (LSF64) thin film model-type electrode. The cathode was electrochemically characterized while quantifying the produced hydrogen by means of mass spectrometry (MS). Model-type SOECs of about 1 cm in diameter were fabricated: The LSF64 cathode was deposited as a thin film by means of pulsed laser deposition on the electrolyte (yttrin-stabilized zirconia). The porous counter electrode made from La_{0.6}Sr_{0.4}Co_{0.7}Fe_{0.3}O_{3-δ} was deposited on the bottom of the samples as a slurry and sintered subsequently. The SOECs were then measured in a sample holder featuring two different gas chambers for anode and cathode. Current-voltage and impedance measurements were performed. In order to obtain the cathode’s DC resistance, the electrolyte resistance extracted from the impedance measurements was subtracted from the total resistance. The resistance of the porous anode was shown to be negligible. Due to slight leakage between the two gas chambers, oxygen was present on the cathode side. The effect of not only producing hydrogen but also pumping oxygen through the cell could be taken into account by quantifying both the oxygen decrease and the hydrogen increase on the cathode side. From the gas concentrations measured by MS the current was calculated via Faraday’s law and compared to the electrically measured current, which were in good agreement (see Figure 5).

![Figure 5. Current-voltage curves.](image)

**References**


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**Nano particles and colloid surface chemistry in mineral processing and waste water treatment**

This paper reviews nanotechnology and colloidal surface chemistry principles and their applications in mineral sustainability. The ideal solution for sustainable mineral processing is one that balances profit, economic development, minimal negative environmental impacts etc. Rankin (2011) refers to sustainable development as the satisfaction of present day need without compromising the needs of future generations. This is an approach that is difficult to maintain in today’s real world mining practice, you find most companies wanting to exploit as much of the valuables as the possibly can. Sustainability is a widely desirable paradigm but there is very little understanding and practice of the concept in mineral development (Rankin, 2011). Over the years, researchers have come up with different technologies and ideas to lead to better practices with respect to mineral and energy resources (Rao, 2003).