COPPER IN RENEWABLE ENERGY SOURCES

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Abstract

Elementary copper keeps its standard role as the main component of generators and connectors in renewable energy sources such as wind generators and hydropower plants. On the other hand, there are copper compounds which exhibit semiconductor properties and are therefore used as active components in electric solar panels. Copper (I) oxide (Cu2O) is the first compound which was used for the conversion of solar energy into electrical energy. Natural copper sulfides (chalcocite, djurleite, covellite) also have semiconductor properties, but also display characteristics of supercapacitors, so the possibility of their use in this type of device is investigated. In recent times there has been intense research of the use of copper-indium-diselenide and its alloys with gallium to produce polycrystalline thin-film semiconductors for solar cells absorber layers. The reason for this is the fact that this compound achieved so far the highest yield in the conversion of solar energy into electricity by 17.7%.

Key words: *copper; copper (I) oxide; copper indium diselenide; solar cells*

Introduction

Growing demands related to green house effect led to the exponential increasing in production and installing of renewable energy sources – wind generators, mini hydropower plants, solar panels etc. In this sources elemental copper kept its role as a constructing material, but also it got a new one as a part of semiconducting compounds which serve as an active material in photovoltaic cells.

II Elemental copper in alternative sources of electrical energy

Figure 1: Global installed wind capacity (MW)

III Solar cells

Global installed photovoltaic capacity in 2014. reached nearly 185 gigawatts. Since 2008 China and Taiwan became leading producers of photovoltaic cells, as shown in Figure 2 . In the same time the prices decrease and in 2014 the average price for Multi-Si Cells was 0.3 US dollars per Watt.

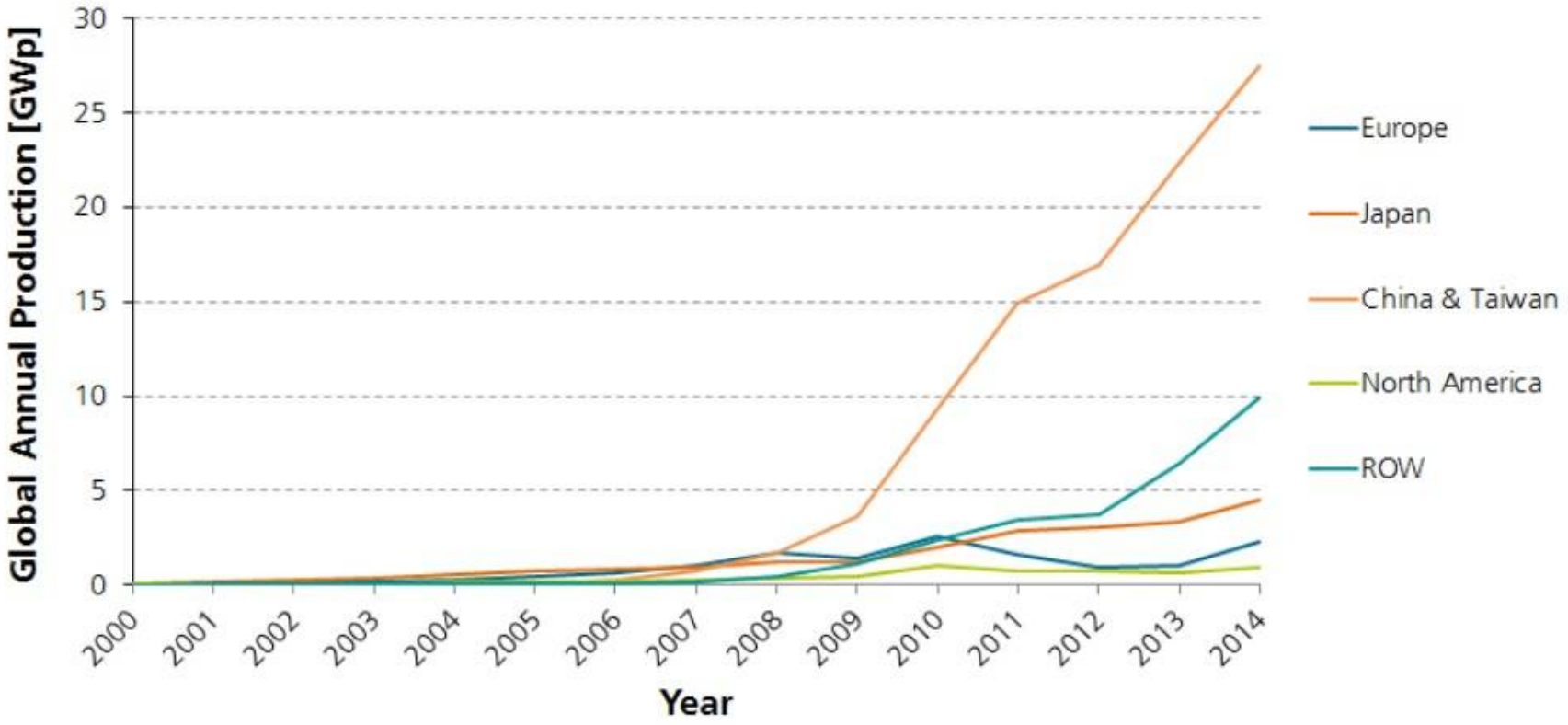

Figure 2 Global anual production of fotovoltaic cells until 2014

III . 1 Cuprous oxide

- Thermal oxidation is the simplest method of cuprous oxide synthesis, but the thickness and the quality of the product is hard to control.
- Electrodeposition technique is much more employed to deposit cuprous oxide powders or thin films. Cu(I)O can be synthesized by anodic oxidation of copper in alkaline sodium chloride solutions [10]. Reactions that take place on the anode are:
- $Cu \rightarrow Cu^{+} + e^{-}$
- followed with the reaction in a bulk of the electrolyte:
- $2Cu^{+} + 2OH^{-} \rightarrow Cu_2O + H_2O$
- By using new technologies (especially nanotechnology), a significant improvement in energy efficiency has been achieved. Uniform films of Cu(I)O with thickness below 1 μm can be prepared by cathodic reduction from a Cu(II) lactate solution. The electrodeposition reaction is:
- $2Cu^{2+} + 2e^{-} + 2OH^{-} \rightarrow Cu_2O + H_2O$
- The deposits are compact and of high purity with the particle size varying from 60 to 400 nm . The morphology and thickness of the film can be modulated by adjusting the synthesis conditions such as temperature, pH, potential and substrate.

III 2 Other compounds containing copper

Sulfide minerals containing copper, like chalcocite (Cu2S), covellite (CuS) and chalcopyrite, CuFeS2, exhibit semiconducting properties, so they are potential, but not promising, active materials for solar energy conversion. Their characteristics are much more suitable for supercapacitor application.

In last decade most of the studies deal with chalcopyrite-based thin film solar cells, most prominently Cu (In, Ga) Se2 (CIGS).

Many groups across the world have developed polycrystalline thin-film solar cells such as CuInSe2 (CIS) and Cu(In,Ga)Se2 (CIGS) with efficiencies in the range of 15–19%, depending on different growth procedures

IV Conclusion

Growing consumption of energy from renewable energy sources preserved the using of copper in its elemental form, but also it got a new role as a part of active components in photovoltaic solar cells.

Thank you!