Advanced Method of Formation of Heteropoly Oxometalate Nanocoating on Electrodes for Direct Biomass Conversion to Energy

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A biomass is CO_2-neutral renewable energy source and in typical biomass-to-electricity systems is firstly gasified in hydrogen rich syngas and than used in ICE or FC based generators to produce electricity. Shorter path from biomass to electricity announced in recent publication by Prof. Deng Yulin et all [1] - liquid-catalyst fuel cell (so called redox flow battery) with polyoxometalates (POMs) as a photo-catalyst to oxidize biomass. Also such fuel cell is completely noble-metal free and can give higher power output as typical microbial fuel cells, it consumes two different POMs catalysts, both in solutions with biomass being cyclically pumped through the anode and cathode tanks – to oxidize biomass on anode and react with the oxygen at the cathode. The disadvantage is that biomass and catalyst must stir together for successful realization of red-ox reaction, and the mixture is circulated along the electrodes while most of biomass reacted. Although it is cheaper than using noble metals, a new portion of POM catalyst is needed for mixing with each fresh biomass portion, because it is not easy recyclable from solution. In this work the method of producing POM catalyst as a thin layer on electrode is proposed. Thin films of POMs are made by spin coating, the LB technique, electrodeposition, surfactant-encapsulation, layer-by-layer self-assembly methods. We tested electrophoretic coating method from solution containing POM clusters and graphene multi-layer stacks. In case of thin film coating the catalyst would not require any stirring with biomass solution and could be used without enrichment. Another advantage is to use steam explosion pre-treatment of biomass to transform and functionalize components of natural polymers from biomass – hemicelluloses and destructed fragments of the lignin [2].

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References

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