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Green energy potential of plant biomass and natural biopolymers

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Nowadays the main energy sources (over 80%) are fossil fuels, namely coal, petroleum and natural gas. The increased use of the fossil fuels is causing acute environmental problems, since emission of carbon dioxide in the volume of 1500-2000 m3 per 1 ton of fuel, triggering the greenhouse effect and global warming of the Earth. Therefore, in recent years, a considerable attention is paid to the production of the green energy from plant biomass, which in contrast to fossil energy sources is neutral for emission of carbon dioxide. Furthermore, the biomass is continuously renewed in the nature as a result of the photosynthesis. Various biomass types involve residues of forest and agricultural plants; residues and waste of textile, pulp and paper industry; municipal paper waste; special energy crops; etc. The total amount of such biomass type that is accumulated annually in the world is estimated to be 10-15 billion tons at least. Currently, the share of biomass-based energy is about 10-12% in the world. The complete use of all energetic potential of non-edible plant biomass can increase the share of the green energy to 30-33% in the world energy consumption. It is known that the plant biomass is a composition of three main biopolymers – cellulose, hemicellulose and lignin, as well as small admixtures of some other components such as protein, pectin, starch, rosin acids, waxes, fats, minerals, etc. Thus, to obtain the net combustion heat of the biomass sample (q), a net heating value (qi) of the individual component and its weight part (wi) in the biomass should be summarized: $q = \Sigma wi\ qi$. On the other hand, a quite precise equation can be derived for calculating the net heating value of the individual component with a low relative deviation up to 1%.

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Towards the selective formate production over nano-micro structured SnOx catalysts in aqueous medium

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In response to the fast consumption of fossil fuels and their associated environmental problems including the notorious greenhouse gas (CO_2), carbon captureand utilization (CCU) methods to convert CO_2 into value-added chemicals or fuels have aroused intense attention worldwide. Among these transformations, using electrochemical reduction to convert CO_2 to CH_4, CH_3OH, HCOOH, C_2H_2, etc. is particularly interesting as it could allow for intermittent and unpredictable renewable energy (i.e., solar or wind) to be stored in the form of these useful small fuels or chemical products. In the process of CO_2 electroreduction reaction (CER), slow kinetic and low production selectivity of CER are major challenges, leading to wastage of energy and the insufficient utilization of resources. Although some electrocatalysts are employed to accelerate the reaction kinetics and improve the selectivity, the processes of CER at the current state of technology are still not practical. Overcoming these challenges of CO_2 reduction under mild conditions would enable development of high efficient fuel-producing devices with practicability, especially for room-temperature CO_2 reduction in aqueous solutions. In view of these facts, we here report the design and synthesis of Sn oxides electrocatalysts with special 3D morphology including micropheric, coralline-like and flower-like structure by simple hydrothermal method. All of these SnOx catalysts were coated on the gas diffusion carbon paper sheets to form target electrodes. To our interesting, all the obtained SnOx exhibited the superb CER catalytic activity and selectivity toward formate production with FE% > 60%, but the electrode modified with coralline-like structured SnOx is more efficient due to its exposed more {002} planes of SnO_2 with FE% reaching to 87%.

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