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Alkane production from biomass: A chemocatalytic liquid phase cellulose-to-naphtha process

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Linear, branched and cyclic alkanes are important intermediates and end products of the chemical industry and are nowadays mainly obtained from fossil resources. More specifically, light naphtha alkanes are useful building blocks for gasoline as well as an ideal source of polymer precursors such as ethylene and propylene. Moreover, dehydrogenation of for example cyclohexane gives interesting aromatics. In search for alternatives, biomass feedstocks are often presented as a renewable carbon source. As a result of its abundance in nature and uniform chemical structure, cellulose is the ideal precursor for light naphtha alkanes. Breaking and formation of C-C bonds is not required, but rather the challenge is to selectively disrupt C-O bonds in the presence of C-C bonds. In this contribution, a one-pot biphasic catalytic system is presented, yielding liquid hydrocarbons directly from (ligno)cellulosic feedstocks. The catalytic reaction proceeds at elevated temperatures under hydrogen pressure in presence of a homogeneous acid, dissolved in the water phase and primarily responsible for cellulose hydrolysis, and a modified Ru/C catalyst, suspended in the organic phase and in control of the catalytic hydrogenation and hydrodeoxygenation activity. In the light of this liquid phase cellulose-to-naphtha process, very interesting results were recently demonstrated towards a real implementation of this technology, based on essential insights in biomass feedstock requirements and self- sufficiency in hydrogen and energy. The first interesting message, which contrasts the general conception of biomass requirements in a biorefinery, is that this cellulose-to-naphtha process preferably consumes large or fibrous cellulose particles. Moreover, the presence of considerable content of lignin and hemicellulose impurities has no significant impact on the cellulose-to-naphtha process. Secondly, in the light of 100% renewability, also a non-fossil resource for H_2, which is consumed during hydrodeoxygenation, is required. Therefore, a completely self-supporting process (based on C, H and energy) is presented.

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