Chemical Energy Storage: Bridging Catalyst & Process Design

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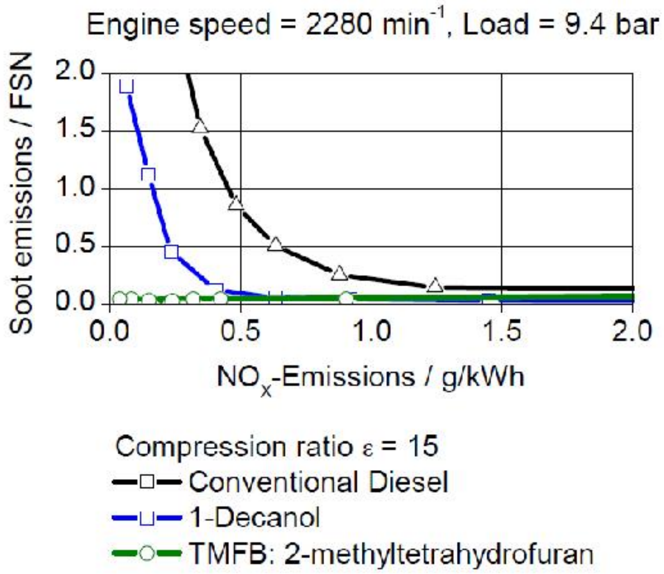
Limited fossil fuel resources and the need for reduced CO_2 emissions foster the use of renewable sources for energy generation. However, the growing share of electrical power generated from renewable resources is accompanied by an increasing fluctuation of solar and especially wind energy feed into the power network which makes new strategies to combine energy supply and demand unavoidable. As large scale storage of electricity is unavailable at the moment. One promising solution to overcome this challenge is the integration of energy-intense fuel production into the power generation process and use the produced fuel as energy storage media.

Two major advantages of liquid fuels are the energy storage density as well as the multi-use capability due to the comparably low handling efforts. Therefore, liquid fuels can be used in a versatile way. The “classical” fuel use in combustion engines for passenger cars or heavy-duty applications is possible at all time as the retail infrastructure exists.

To cope with these challenges, suitable catalytic processes for the production of fuels based on renewable carbon sources such as biomass and CO_2 are necessary. Energy and/or reduction equivalents are provided based on surplus energy. This energy is transformed into renewable hydrogen in water electrolysis or used directly in electrocatalytic processes.

Herein, the potential use of biomass as renewable carbon source for the production of biofuels for mobile application and as liquid energy storage systems will be discussed. Potential valorization schemes of biogenic feedstocks usually rely on a selective defunctionalization to reduce the high oxygen content of these compounds while increasing energy density. However, selectivity of the transformation, carbon efficiency and hydrogen demand have to be considered. Additionally, potential areas of application of these biofuels pose different challenges on the chemical nature of the targeted biofuels.

An example of a potential biofuel compound presents 2-MTHF (2-methyltetrahydrofuran) which can be produced based on cellulose and sugars. Interestingly, it does not only exhibit comparable energy density and combustion performance compared to conventional diesel. Additionally, it enables drastically reduced NO_x and soot emission establishing the strong influence of the chemical structure of novel fuel compounds and the need for a comprehensive understanding of structure-performance correlations.



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Literature:

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