

Supplementary Information (SI)

1. The effect of calcination and reduction temperature on the performance of Ni/Al₂O₃ and Co/Al₂O₃ catalysts

An increase in the calcination temperature of the as-prepared Ni/Al₂O₃ sample from 350 to 750 °C and the subsequent reduction of the calcined sample at 450 °C resulted in a significant drop in LaAc conversion from 35% to below 5% (Fig. 1SA). This result did not agree with the study of Kumar, et al. [1] who demonstrated the increasing activity of alumina supported Ni catalysts in hydrodeoxygenation of stearic acid with the growth of calcination temperature. Since this effect was not observed in our experiments, the as-prepared Ni/Al₂O₃ catalysts were calcined at T=350 °C that was sufficient for the decomposition of the supported nitrates. The effect of reduction temperature was investigated for the calcined Ni/Al₂O₃ in the temperature range of 350-500 °C. Only a slight difference in LaAc conversion in the range of 42-47% was observed between the catalysts reduced in the temperature range of 400-500 °C, but a decrease in reduction temperature to 350 °C resulted in a noticeable decrease in the conversion to 35% (Fig. 1SB). Based on these results, all subsequent experiments with Ni/Al₂O₃ catalysts were carried out using the reduction temperature of 450 °C. In case of Co/Al₂O₃, the change of calcination temperature in the range of 325-400 °C introduced only a minor impact on LaAc conversion (Fig. 1SC). While the largest LaAc conversion was observed upon Co/Al₂O₃ catalyst calcined at 350 °C and reduced in the temperature range of 350-375 °C (Fig. 1SD). Both increasing and decreasing the reduction temperature relative to this range resulted in a decrease in the acid conversion. Based on these results, both calcination and reduction temperature for the cobalt catalyst was chosen as 350 °C.

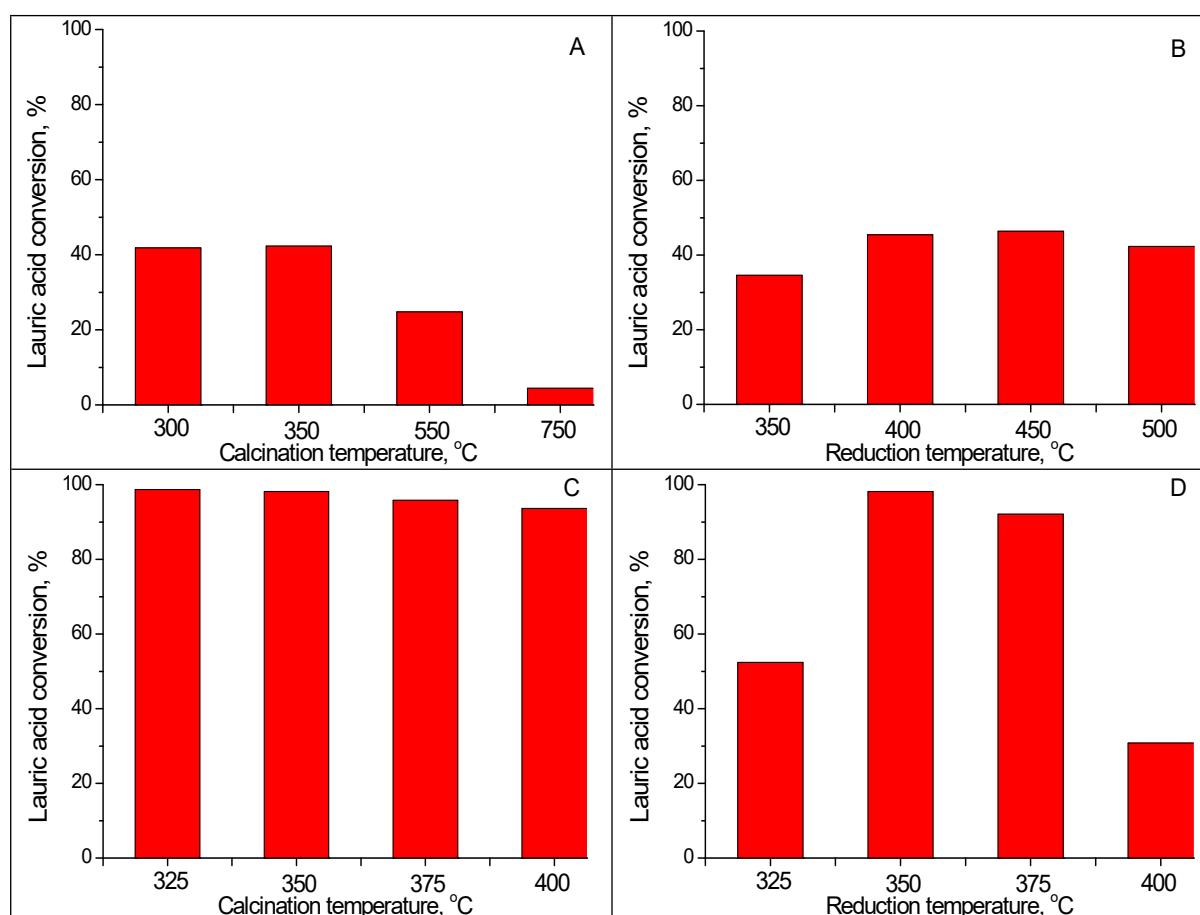


Fig. 1S. The impact of precursor calcination temperature and calcined catalyst reduction on the catalytic performance of Ni/Al₂O₃ (A,B) and Co/Al₂O₃ (C,D) catalysts in lauric acid hydroconversion. A). Ni/Al₂O₃ catalyst calcined at different temperatures and reduced at T=450 °C. B). Ni/Al₂O₃ catalyst calcined at T=350 °C and reduced at different temperatures. C). Co/Al₂O₃ catalyst calcined at different temperatures and reduced at T=450 °C. D). Co/Al₂O₃ catalyst calcined at T=350 °C and reduced at different temperatures. Lauric acid - 20.0% (wt.) in decalin, total weight of reaction mixture - 100 g, m_{cat.}= 1.0 g. T = 280 °C, p_{H2} = 40 bar, reaction time= 180 min. (A,B) or 60 min. (C,D), RPM = 600.

2. The conversion of 1-dodecene in presence of Co/Al₂O₃ catalyst.

To explain the formation of hydrocarbons other than C11 and C12 during the hydroconversion of LaAc in presence of Co/Al₂O₃, a special experiment was carried out with 1-dodecene as a reactant at the same reaction conditions.

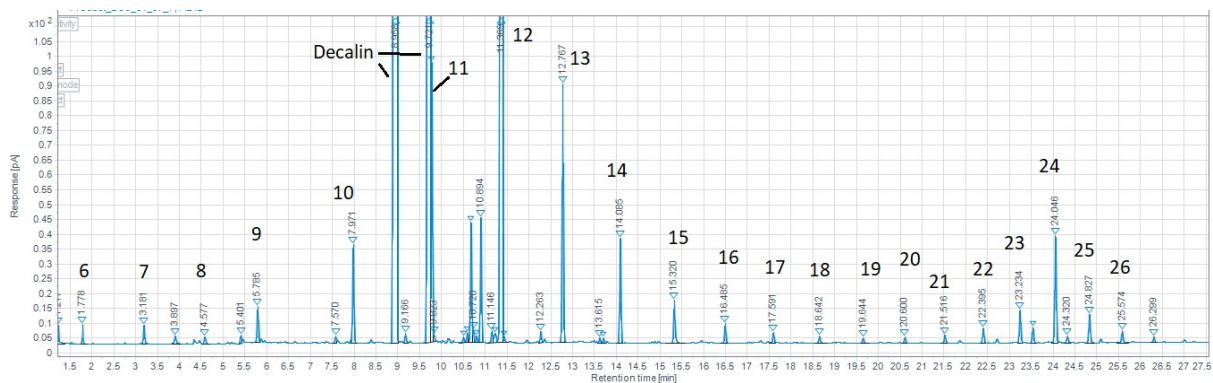


Fig. 2S. The GC diagram of reaction product formed by the hydroconversion of 1-dodecene on Co/Al₂O₃. The number of C atoms in a hydrocarbon is shown near a corresponding peak on the diagram. 1-dodecene - 17.0% (wt.) in decalin, total weight of reaction mixture - 100 g, m_{cat.}= 1.0 g. T = 280 °C, p_{H2} = 40 bar, reaction time= 5 min.

Fig. 2S depicts the GC diagram of a reaction product formed by the hydroconversion of 1-dodecene on Co/Al₂O₃. Already after 5 minutes of the reaction different hydrocarbons were formed ranging from C6- to C26+. The expressed formation of C24 compound among reaction products allows assuming that the initial step of 1-dodecene conversion could be its dimerization followed by a cracking step.

3. Table 1S. The composition of gaseous products formed during LaAd conversion in N₂ atmosphere in presence of Ni/Al₂O₃ catalyst. T=280 °C, p_{N2}=40 bar, lauryl aldehyde - 20.0% (wt.) in decalin, total weight of reaction mixture - 100 g, m_{cat.}= 1.0 g.

| Component | Content, %vol. |
|---|----------------|
| H ₂ | 1.5 |
| CO | 29.9 |
| CO ₂ | 6.1 |
| CH ₄ | 4.3 |
| Hydrocarbons C ₂ -C ₅ | 1.3 |

4. Co-conversion of LaAd and n-dodecane on Ni/Al₂O₃ in N₂ atmosphere.

To check a possibility for the dehydrogenation of alkanes on Ni/Al₂O₃ in N₂ atmosphere, the co-conversion of LaAd and n-dodecane was carried out. Fig. 3S demonstrates that at chosen reaction conditions the Ni/Al₂O₃ catalyst possessed poor dehydrogenating properties with minor n-dodecane conversion. While the conversion of LaAd led to the considerable C11 olefins formation, as it was proved by GCMS. These results allowed suggesting that the group of C11 olefins were hardly formed by the direct DCO route via C-C hydrogenolysis followed by the dehydrogenation of formed C11 alkanes. 2-Tridecanon detected by GCMS was mentioned among the reaction products of lauric acid conversion through di-undecyl ketone intermediate [2]. Nevertheless, this reaction route assumed the simultaneous formation of 1-decene. In our experiments the formation of C10 hydrocarbons was not observed, so 2-tridecanone could also be formed by another reaction route.

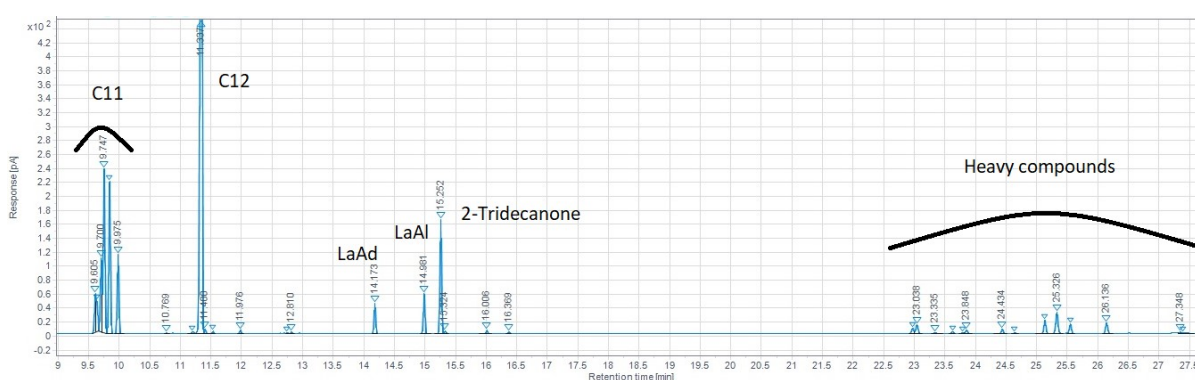


Fig. 3S. The GC diagram of reaction product formed by the co-conversion of LaAd and n-dodecane on Co/Al₂O₃ in N₂ atmosphere. LaAd – 18% (wt.) and n-dodecene - 17.0% (wt.) in isoctane, total weight of reaction mixture - 100 g, m_{cat.} = 1.0 g, T = 280 °C, p_{N₂} = 40 bar, reaction time= 180 min.

5. The hydroconversion of LaAc on Ni/Al₂O₃ with larger catalyst loading and increased reaction time.

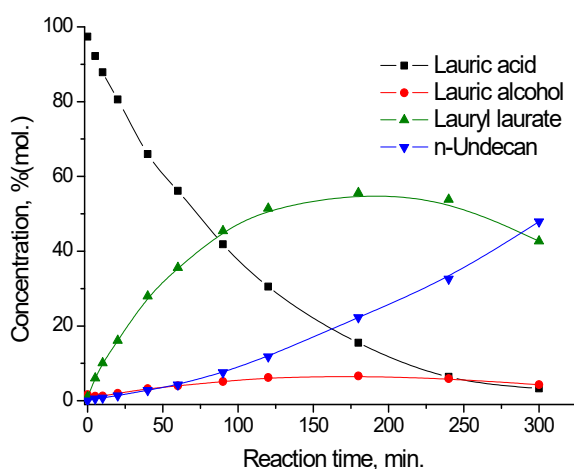


Fig. 4S. The composition of reaction mixture formed by the hydroconversion of lauric acid in presence of Ni/Al₂O₃. T=280 °C, p_{H₂}=40 bar, lauric acid - 20.0% (wt.) in decalin, total weight of reaction mixture - 100 g, m_{cat.} = 3.0 g.

References

1. P. Kumar, S.K. Maity and D. Shee, *Chem. Eng. Commun.*, 2020, **207**, 904-919.
2. E. Vonghia, D.G.B. Boocock, S.K. Konar and A. Leung, *Energy Fuels*, 1995, **9**, 1090-1096.