

Blekkann *et al.*, [10] have explained the reaction of n-heptane over the oxidized carbide catalyst in terms of a bond-shift mechanism via a metallocyclobutane intermediate. Furthermore, oxidation of metal carbide has been shown to lead to an active and selective material in the isomerization of alkanes [22,10]. Therefore, catalyst carburized at 823 K is catalytically active phase possibly because it produces an oxycarbide consisting of a Mo₂C lattice where oxygen replaces some carbon atoms in the interstitial voids [10]. It can further be deduced that the oxycarbide is capable of producing sites for hydrogenation and dehydrogenation, this may result in forming olefinic intermediates, which can then be isomerized. Hence, the better results were observed when the catalyst was characterized at 823 K.

4. Conclusions

In-situ TPR and TPO were able to differentiate between the surface of catalysts carburized at ≥ 923 K and below 923 K. *In-situ* TPO showed the surfaces of the catalysts to contain the similar amount of carbonaceous deposit, while TPR showed their ability to consume hydrogen in different amounts. These observations suggested the presence of oxygen in the catalyst carburized at 823 K due to the incomplete reduction. The catalyst carburized at 823 K proved to be approximately four times better in both isomer selectivity and conversion compared to catalyst carburized at ≥ 923 K.

References

- [1] J.B. Claridge, A.P.E. York, A.J. Brungs, *J. Catal.* 100 (1998) 85–100.
- [2] J.S. Lee, S.T. Oyama, M. Boudart, *J. Catal.* 133 (1987) 125–133.
- [3] W. Wu, Z. Wu, C. Liang, *J. Phys. Chem. B* 107 (2003) 7088–7094.
- [4] Z. Li, C. Chen, E. Zhan, *Chem. Commun.* 50 (2014) 4469–4471.
- [5] A. Galadima, R.P.K. Wells, J.A. Anderson, *Appl. Petrochem. Res.* 1 (2012) 35–43.
- [6] S.T. Oyama, C.C. Yu, S. Ramanathan, *J. Catal.* 184 (1999) 535–549.
- [7] J.S. Lee, S. Locatelli, S.T. Oyama, M. Boudart, *J. Catal.* 125 (1990) 157–170.
- [8] T.C. Xiao, A.P.E. York, V.C. Williams, *Chem. Mater.* 12 (2000) 3896–3905.
- [9] P. Del Gallo, C. Pham-Huu, A.P.E. York, M.J. Ledoux, *Ind. Eng. Chem. Res.* 35 (1996) 3302–3310.
- [10] E.A. Blekkann, C. Pham-Huu, M.J. Ledoux, *J. Guille, Ind. Eng. Chem. Res.* 33 (1994) 1657–1664.
- [11] C. Pham-Huu, P. Del Gallo, E. Peschiera, M.J. Ledoux, *Appl. Catal. A* 132 (1995) 77–96.
- [12] M.J. Ledoux, C. Pham-Huu, A.P.E. York, *The Chemistry of Transition Metal Carbides and Nitrides*, S.T. Oyama, Ed., Blackie New York, 1996, pp. 373–397.
- [13] F.F. Oloye, A.J. McCue, J.A. Anderson, *Catal. Today* 277 (2016) 246–256.
- [14] C. Bouchy, C. Pham-Huu, B. Heinrich, *Appl. Catal. A* 215 (2001) 175–184.
- [15] M.J. Ledoux, P. Del Gallo, C. Pham-Huu, A.P.E. York, *Catal. Today* 27 (1996) 145–150.
- [16] T. Matsuda, K. Watanabe, H. Sakagami, N. Takahashi, *Adsorption* 242 (2003) 267–274.
- [17] T. Xiao, A.P.E. York, H. Al-Megren, *C.R. Acad. Sci. Ser. II: Chim.* 3 (2000) 451–458.
- [18] C. Bouchy, C. Pham-Huu, B. Heinrich, *J. Catal.* 190 (2000) 92–103.
- [19] N. Perret, X. Wang, L. Delannoy, *J. Catal.* 286 (2012) 172–183.
- [20] F.F. Oloye, A.J. McCue, J.A. Anderson, *Appl. Petrochem. Res.* 6 (2016) 341–352.
- [21] J. Song, Z.F. Huang, L. Pan, J.J. Zou, X. Zhang, L. Wang, *ACS Catal.* 5 (2015) 6594–6599.
- [22] M.J. Ledoux, C. Pham-Huu, H. Dunlop, J. Guille, *Stud. Surf. Sci. Catal.* 75 (1993) 955–967.