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Neodymium-doped alkaline-earth oxide catalysts for propane oxidative dehydrogenation. Part II. Catalytic properties

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Abstract

Two series of alkaline-earth oxides of Mg, Ca, and Sr, doped with 5 mol% Nd_2O_3 and synthesised by two different procedures: (i) evaporation of nitrate aqueous solutions followed by nitrate decomposition and (ii) sol–gel technique, have been studied for propane oxidative dehydrogenation reaction. Solid solutions of both Nd in alkaline-earth oxides and of alkaline-earth elements in Nd_2O_3 were shown to be formed as a result of both preparation procedures. It was observed that Nd increased strongly propane conversion, while propene and ethene selectivity generally followed the catalyst basicity measured by CO_2-TPD. The sol–gel preparation led to materials exhibiting enhanced alkene selectivity, higher basicity and higher content of structural defects. The selectivity was observed to increase with propane conversion at increased contact time at difference with what was usually reported for redox-type catalysts. The relationship between catalyst preparation method, solid solution formation, lattice structural defects, surface basicity, and catalytic performance has been discussed.

Graphical abstract

Two series of 5 mol% Nd_2O_3–AEO (AEO = MgO, CaO, SrO) were synthesised by: (i) evaporation of nitrate solutions followed by nitrate decomposition and (ii) sol–gel technique. The obtained mixed oxides were studied in propane oxidative dehydrogenation. The relationship between catalyst preparation method, surface basicity, solid solution formation, lattice structural defects, and