LUXFER
MEL TECHNOLOGIES

DATASHEET • 1035 †

Solid Acid Materials for Industrial Catalysis

Appearance and general characteristics

Luxfer MEL Technologies supplies a wide range of zirconium compounds (hydroxides and oxides) for different industrial chemical processes, including hydrogenation, biomass conversion, isomerization and alkylation; offering attractive advantages in properties, e.g. thermal stability, various particle sizes, porosity and acidity.

Materials are solid white powders, odorless, with the dopant content 0-30 wt%. A wide range of dopants are available.

Advantages

Easy separation from reaction media

Catalysts can be easily separated from the reaction media. They do not form non-desirable by-products.

High activity

Catalysts show good catalytic activity due to their high acidity, which is stronger than 100% H_2SO_4 (Hammett function H_0=-14-16). Also they have developed porosity and defined crystalline structure.

Resistance to poisoning

Catalysts can tolerate up to 20ppm water in the feed, and also higher levels of benzene and C7+ straight chain fractions in refinery applications.

Reusability

Catalysts can be used several times during reaction cycle.

Low temperature operation

Zirconia superacids operate in the temperature range 120-190 ˚C, which is significantly lower than other catalysts e.g. zeolites (250-280 ˚C).

Environmentally friendly

Zirconia superacids do not release any halogen containing or other compounds which might corrode equipment.

Mode of action

The catalytic cycle of the acid catalyzed isomerization involves chain initiation to form the first active carbenium ion species, carbenium ion rearrangement and the chain propagation. Solid acid catalysts release proton, which favors to alkene protonation to form active carbenium ion.

Alkylation of isobutane with light olefins in the presence of solid acid catalyst is based on the series of consecutive reactions occurring through carbocation intermediates. The addition of proton (from solid acid catalyst) to an olefin leads to a t-butyl cation formation, which then combines with an olefin (e.g. C4) to give the corresponding C8 carbocation, which may isomerize via hydride transfer and methyl shifts to form more stable cations.

How to use solid acid materials

Amorphous sulfated zirconium hydroxides need activating by calcining at 500-600 ˚C; tungstated – 500-700 ˚C (preferably in static air) for 2-3 h immediately before use. The optimum temperature will depend upon the acidity requirements of the reaction being catalyzed. Calcined materials (e.g. oxides) should be dried at 300 ˚C for 1 h immediately before use.

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Acidity characteristics of solid acid materials

R1, R2 –commercial grades; R3- new generation of development materials

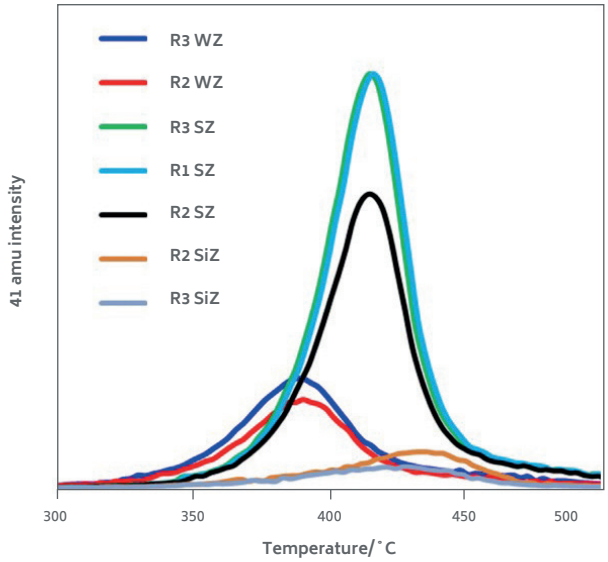


Figure 1. Propene 41 amu MS signal – TGA-MS.

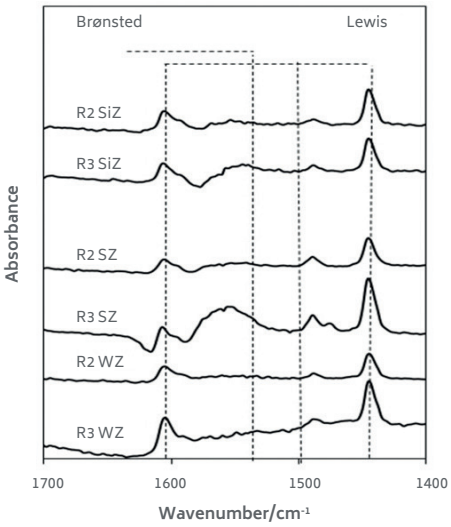
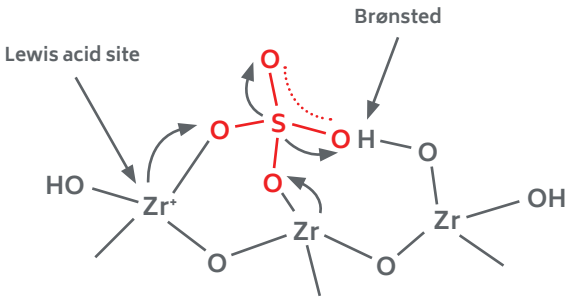
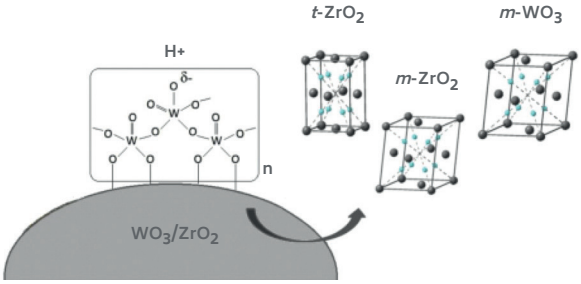


Figure 2. Py-DRIFT spectra.

Sulphated zirconia structure[1]



Tungstated zirconia structure[2]



References

1. Green Chemistry, 6, 2014
2. Catalysis Today, 329, 2019

Discover more at

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† The information contained within is meant as a guideline only

Certificate No. FM12677

Luxfer MEL Technologies
Elektron Technology Centre, Lumns Lane,
Manchester, M27 8LN
T +44 (0) 161 911 1000

Luxfer MEL Technologies
500 Barbertown Point Breeze Road,
Flemington, NJ 08822
T +1 908 782 5800