$$\text{conversion of ethane} = \frac{[CO]/2 + [CO_2]/2 + [C_2H_4] + [CH_3COOH]}{[CO]/2 + [CO_2]/2 + [C_2H_4] + [C_2H_6] + [CH_3COOH]}$$

selectivity (efficiency) to ethylene and acetic acid =

$$\frac{[C_2H_4] + [CH_3COOH]}{[CO]/2 + [CO_2]/2 + [C_2H_4] + [C_2H_6] + [CH_3COOH]}$$

One application of a catalytic ethane to ethylene and acetic acid process would be as a front end process for commercial vinyl acetate monomer (VAM) synthesis. The reaction of acetic acid with ethylene (acetoxylation) is the dominant route to vinyl acetate today. Because current vinyl acetate process technology is mature, accomplishing significant improvements has become increasingly difficult. A reduction in feedstock costs would lead to cost-savings in the production of VAM. The use of ethane and oxygen as starting feedstock would represent a significant savings in raw material cost over the currently-used ethylene and acetic acid.

It would be desirable to have a process which reacts ethane with oxygen over a catalyst to selectively coproduce a product stream comprising ethylene and acetic acid, which product stream could be used in VAM production.

SUMMARY

In a first ~~aspect~~embodiment of the present discosure, there is provided a process comprising catalytically converting ethane to ethylene and acetic acid in the presence of oxygen at a temperature of 450°C or less in the gas phase wherein the catalyst has the empirical formula $MoV_aNb_bTe_cZ_dO_n$ wherein Z is at least one element selected from the group consisting of W, Cr, Ta, Ti, Zr, Hf, Mn, Re, Fe, Ru, Co, Rh, Ni, Pd, Pt, Ag, Au, Zn, B, Al, Ga, In, Ge, Sn, Pb, P, Bi, Y, rare earth elements and alkaline earth elements, a = 0.01 to less than 1.0, b = 0.01 to less than 1.0, c = 0.01 to less than 1.0, d = 0.0 to less than 1.0 and n is determined by the oxidation states of the other elements.

Surprisingly, the process can be operated at very high selectivity to ethylene.

In a first aspect, there is provided a process comprising catalytically converting ethane to ethylene and acetic acid in the presence of oxygen at a temperature of 450°C or less in the gas phase wherein the catalyst has the empirical formula $MoV_aNb_bTe_cZ_dO_n$ wherein Z is Pd, a = 0.01 to less than 1.0, b = 0.01 to less than 1.0, c = 0.01 to less than 1.0, d = 0.0 to less than 1.0 and n is determined by the oxidation states of the other elements.

WHAT IS CLAIMED IS:

1. A process comprising catalytically converting ethane to ethylene and acetic acid in the presence of oxygen at a temperature of 450°C or less in the gas phase wherein the catalyst has the empirical formula $MoV_aNb_bTe_cZ_dO_n$ wherein Z is ~~at least one element selected from the group consisting of W, Cr, Ta, Ti, Zr, Hf, Mn, Re, Fe, Ru, Co, Rh, Ni,~~ Pd, ~~Pt, Ag, Au, Zn, B, Al, Ga, In, Ge, Sn, Pb, P, Bi, Y, rare earth elements and alkaline earth elements,~~ a = 0.01 to less than 1.0, b = 0.01 to less than 1.0, c = 0.01 to less than 1.0, d = 0.0 to less than 1.0 and n is determined by the oxidation states of the other elements.

2. The process of Claim 1 wherein the converting is conducted at a pressure of from 1 to 30 atmospheres absolute.

3. The process of any of the preceding claims wherein the converting is conducted at a temperature of from 150°C to 450°C.

4. The process of any of the preceding claims wherein at least part of the product of the process is employed in the production of vinyl acetate.

5. The process of any of the preceding claims wherein the ratio of ethylene to acetic acid is less than 2.

6. The process of any of the preceding claims wherein unreacted ethane is purified and recycled.

7. The process of any of the preceding claims wherein the product acetic acid is condensed.

8. The process of any of the preceding claims wherein ~~Z is Pd and~~ d is greater than 0.

9. The process of any of the preceding claims wherein the converting is conducted in a reactor system ~~comprises~~comprising one or more fixed and/or fluidized bed reactors.

10. The process of Claim 9 wherein the system comprises more than one reactor and one of the reactors is in catalyst regeneration mode.