small variations in calcination conditions (e.g. temperature) appeared to significantly impart the performance of the catalyst. For commercial application it would be desirable to have a shorter calcination time and fewer calcination units.

It is an object of the invention to overcome one or more of the problems described above.

## SUMMARY ~~OF THE INVENTION~~

In broad embodiment~~aspect~~, the present disclosure~~invention~~ relates to method of making mixed metal oxide catalyst compositions that exhibit an ability to facilitate ammoxidation or oxidation of a saturated hydrocarbon to the corresponding unsaturated nitrile or unsaturated carboxylic acid in high yield, and processes using these catalysts for economical conversions of lower alkane hydrocarbons. Generally, the mixed metal oxide catalyst compositions of the present disclosure~~invention~~ comprise, as component elements, molybdenum (Mo), vanadium (V), niobium (Nb) and at least one active element selected from the group consisting of antimony (Sb) and tellurium (Te). In an embodiment compositions of this disclosure~~invention~~ comprise oxides of molybdenum, vanadium, antimony, niobium, at least one element selected from the group consisting of lithium, titanium, tin, germanium, zirconium, hafnium, and optionally at least one lanthanide selected from the group consisting of lanthanum, praseodymium, neodymium, samarium, europium, gadolinium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium. In an embodiment compositions of this disclosure~~invention~~ comprise oxides of molybdenum, vanadium, tellurium, niobium, at least one element selected from the group consisting of lithium, titanium, tin, germanium, zirconium, hafnium, and optionally at least one lanthanide selected from the group consisting of lanthanum, praseodymium, neodymium, samarium, europium, gadolinium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium.

In particular, the present disclosure~~invention~~ discloses a method of heat treating or calcining a solid precursor to the above mixed metal oxide catalyst compositions.

The present disclosure~~invention~~, therefore, discloses a method of preparation of a mixed oxide catalyst comprising as component elements, molybdenum (Mo), vanadium (V) niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te), that can be used for ammoxidation or oxidation of propane and iso-butane in the gaseous phase, said method comprising elevating in the presence of flowing gas a precursor solid mixture comprising compounds of molybdenum (Mo), vanadium (V), niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te) at a first heating rate greater than about 15°C/min at least once until the solid mixture attains a

temperature of not greater than 400°C.

In an aspect, there is provided a method for preparing a mixed oxide catalyst for use in producing acrylonitrile or methacrylonitrile from propane or isobutene by ammoxidation in a gaseous phase comprising the elements molybdenum (Mo), vanadium (V), niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te), said method comprising heating a precursor solid mixture of said mixed oxide catalyst comprising compounds of molybdenum (Mo), vanadium (V) niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te), in contact with flowing gas, at a first heating rate greater than 15°C/min until the precursor solid mixture attains a precalcination temperature of not greater than 400°C.

In one embodiment of the present disclosure,~~this invention~~ the precursor solid mixture is maintained at a constant temperature in the range of about 300 to about 400°C for a period of about 1 to about 4 hours.

The present disclosure~~invention~~ also discloses a method of preparation of a mixed oxide catalyst comprising as component elements, molybdenum (Mo), vanadium (V), niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te), that can be used for ammoxidation or oxidation of propane and iso-butane in the gaseous phase, said method comprising introducing in the presence of flowing gas a precursor solid mixture comprising compounds of molybdenum (Mo), vanadium (V), niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te) into a hot zone maintained at a hot zone temperature greater than about 100°C, greater than about 200°C, greater than about 300°C, or greater than about 400°C.

In another aspect, there is provided a method for preparing a mixed oxide catalyst for use in producing acrylonitrile or methacrylonitrile from propane or isobutene by ammoxidation in a gaseous phase comprising the elements molybdenum (Mo), vanadium (V), niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te), said method comprising heating a precursor solid mixture, comprising compounds of molybdenum (Mo), vanadium (V) niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te), in contact with flowing gas, at a first heating rate greater than 15°C/min until the precursor solid mixture attains a temperature of not greater than 400°C, further contacting the precursor solid mixture with a hot zone temperature greater than 100°C.

For a more complete understanding of the present disclosure~~invention~~, reference should be made to the embodiments described in greater detail below and by way of examples of the present disclosure~~invention~~.

## FIGURE BRIEF DESCRIPTION

Fig. 1 schematically illustrates that the present process provides improved acrylonitrile yield as the first heating rate increases according to an embodiment of the present invention.

Fig. 2 schematically illustrates DSC temperature points comprising reactions of the present process.

Fig. 3 schematically illustrates TGA temperature points comprising reactions of the present process.

## GENERAL DESCRIPTION

The present invention comprises a method for preparing a mixed oxide catalyst for use in producing acrylonitrile or methacrylonitrile from propane or isobutene by ammoxidation in a gaseous phase comprising the elements molybdenum (Mo), vanadium (V), niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te), further comprising heating precursor solid mixture, comprising compounds of molybdenum (Mo), vanadium (V) niobium (Nb), oxygen (O) and at least one element selected from the group consisting of antimony (Sb) and tellurium (Te), contacting with flowing gas at a first heating rate greater than about 15°C/min until the precursor solid mixture attains a precalcination