CLAIMS

1 A method of producing an ethylenically unsaturated carboxylic acid or ester, preferably an α, ß ethylenically unsaturated carboxylic acid or ester, comprising the steps of contacting formaldehyde or a suitable source thereof with a carboxylic acid or ester in the presence of a catalyst and optionally an alcohol, wherein the catalyst comprises group II metal phosphate crystals having rod or needle like morphology ~~or a suitable source thereof~~.

2 A method according to claim 1, wherein the phosphate is selected from hydroxyapatite, pyrophosphate, hydroxyphosphate, PO_4^{2-} phosphate and mixtures thereof.

3 A method according to claim 1 or 2, wherein the group II metal of the phosphate is selected from Ca, Sr or Ba or mixtures thereof.

4 A method according to any of claims 1 to 3, wherein the catalysts are selected from strontium hydroxyapatite and calcium hydroxyapatite.

5 A method according to any of claim 1 to 4, wherein the catalyst is at least 50% w/w metal phosphate.

~~6 A method according to any of claims 1 to 5, wherein the selectivity of the reaction to ethylenically unsaturated carboxylic acid or ester, preferably α, ß ethylenically unsaturated carboxylic acid or ester product, especially (alk)acrylic acid or alkyl (alk)acrylate product is at least 40 mole %.~~

~~7~~6 A method according to any of claims 1-~~6~~5, wherein the catalyst of the invention has its surface layer of crystals depleted below the hydroxyapatite metal to phosphate ratio of 1.67.

~~8~~7 A method according to claim ~~7~~6, wherein the crystal surface metal:phosphorus (M:P) ratio is between 1.30 and 1.55.

~~9~~8 A catalyst system comprising a crystalline metal phosphate catalyst and a catalyst support wherein the metal phosphate has rod~~/~~ and/or needle like morphology.

~~10~~9 A method according to any of claims 1-~~8~~7, wherein the carboxylic acid or ester reactant of the present invention is of formula R^3-CH_2-$COOR^4$, wherein R^4 is either hydrogen or an alkyl group and R^3 is either hydrogen, an alkyl or aryl group.

~~11~~10 A method according to any of claims 1-~~8~~7, or ~~10~~9 wherein the ethylenically unsaturated acid or ester produced by the process of the invention is selected from acrylic, alkacrylic, 2-butenoic, cyclohexenoic, maleic, itaconic and fumaric acids and their alkyl esters, and also methylene substituted lactones.

~~12~~11 A method according to any of claims 1-~~8~~7, ~~10~~9 or ~~11~~10, wherein doping elements are present in the catalyst at a level up to 20 mol % of the metal M.

~~13~~12 A method according to claim ~~12~~11, wherein the doping metal cations are selected from Cs, K, Rb, Na,

Li, Zn, Ti, Si, Ln, Ce, Eu, Mg (if not used as a group II metal), Ba (if not used as a group II metal), Pb, Cd, Ag, Co, Cu, Ni and Zr.

~~14~~13 A method according to any of claims 1-~~8~~7, or ~~10~~9-~~12~~11, wherein doping anions are present in the catalyst at a level of up to 20 mol % phosphate.

~~15~~14 A method according to claim ~~14~~13, wherein the doping anions are selected from carbonate, chloride and fluoride.

~~16~~15 A method or catalyst system according to any preceding claim wherein the catalyst is on a support selected from alumina, silica, silicon nitride, silicon carbide, colloidal silica, titania or aluminium phosphate.

~~17~~16 A method according to any of claims 1-~~8~~7, or ~~10~~9-~~16~~15, wherein the M:P mole ratio is between 0.8-1.8.