2004-323403 A

[Patent Literature 5] JP Patent Publication (Kokai) No. 2008-120796 A

[Patent Literature 6] JP Patent Publication (Kokai) No. 2009-263242 A

[Patent Literature 7] JP Patent Publication (Kokai) No. 2009-263241A

[Non Patent Literature]

[0008]

[Non Patent Literature 1] Byung Y.Y. and Montgomery R., Carbohydrate Research, Vol. 280 (1996) p.27-45

[Non Patent Literature 2] Byung Y.Y. and Montgomery R., Carbohydrate Research, Vol.280 (1996) p.47-57

[Non Patent Literature 3] Niemelae K. and Sjoestroem E., Biomass, 11 (1986) p.215-221

[Non Patent Literature4]Armando T.Q. et al., Journal of Hazardous Materials, B93 (2002)

[Summary ~~of Invention~~]

[Technical Problem]

[0009]

An object of the present disclosure~~invention~~ is to provide an alternative method for efficiently producing lactic acids from a carbohydrate-containing raw material.

[Solution to Problem]

[0010]

As a result of intensive studies to achieve the above object, the present inventors have found that lactic acids (lactic acid and/or

lactic acid ester) can be efficiently produced from a carbohydrate-containing raw material using as a catalyst at least one type of compound selected from the group consisting of a tin compound, an indium compound, and a rhenium compound, even when a small amount of the catalyst is used. Also, the present inventors have found that lactic acids (lactic acid and/or lactic acid ester) can be efficiently produced from a carbohydrate-containing raw material using at least one type of compound selected from the group consisting of a tin compound, an indium compound, and a rhenium compound and at least one type of compound selected from the group consisting of a first transition series metal compound, a lithium compound, a magnesium compound, an alkali metal salt, an alkaline earth metal salt, a quaternary ammonium salt, and a quaternary phosphonium salt, in combination as a catalyst. They have completed the present disclosure~~invention~~ based on these findings.

[0010a]

In a first aspect, there is provided a method for producing lactic acid and/or lactic acid ester by heat treatment on a carbohydrate-containing raw material in a solvent containing a catalyst, wherein the catalyst is tin or organic tin perfluoroalkylsulfonate, and the solvent contains water and/or alcohol.

[0011]

Specifically, the present invention encompasses the following [1] to [9].

[0012]

[1] A method for producing lactic acid and/or lactic acid ester by heat treatment on a carbohydrate-containing raw material in a solvent containing a catalyst, wherein:

the catalyst is at least one type of compound selected from the group consisting of a tin compound, an indium compound, and a rhenium compound; and

the solvent contains water and/or alcohol.

[0013]

CLAIMS

~~[Claim 1] (Cancelled)~~

~~[Claim 2] (Cancelled)~~

~~[Claim 3] (Cancelled)~~

~~[Claim 4] (Cancelled)~~

~~[Claim 5] (Cancelled)~~

~~[Claim 6] (Cancelled)~~

~~[Claim 7] (Cancelled)~~

~~[Claim 8] (Cancelled)~~

~~[Claim 9] (Cancelled)~~

[Claim 1~~0~~] ~~(Added)~~ A method for producing lactic acid and/or lactic acid ester by heat treatment on a carbohydrate-containing raw material in a solvent containing a catalyst, wherein

the catalyst is tin or organic tin perfluoroalkylsulfonate, and

the solvent contains water and/or alcohol.

[Claim 2~~1~~] ~~(Added)~~ The method for producing lactic acid/lactic acid ester according to claim 1~~0~~, wherein the catalyst further contains at least one type of compound selected from the group consisting of a tin compound, an indium compound, and a rhenium compound.

[Claim 3~~2~~] ~~(Added)~~ The method for producing lactic acid/lactic acid ester according to claim ~~1~~0 1 or ~~1~~2, wherein the solvent further contains at least one type of compound selected from the group consisting of a first transition series metal compound, a lithium compound, a magnesium compound, an alkali metal salt, an alkaline earth metal salt, a quaternary ammonium salt, and a quaternary phosphonium salt.

[Claim 4~~3~~] ~~(Added)~~ The method for producing lactic acid/lactic acid ester according to any one of claims 1~~0~~ to 3~~2~~, wherein at least one type of compound selected from the group consisting of a tin compound, an indium compound, and a rhenium compound and at least one type of compound selected from the group consisting of a first transition series metal compound, a lithium compound, a magnesium compound, an alkali metal salt, an alkaline earth metal salt, a quaternary ammonium salt, and a

quaternary phosphonium salt form an ate complex.

[Claim 5~~14~~] ~~(Added)~~ The method for producing lactic acid/lactic acid ester according to any one of claims ~~10~~ 1 to ~~13~~4, wherein the indium compound is selected from the group consisting of a halide salt, carboxylate, indium alkoxide, and indium acetylacetate.

[Claim 6~~15~~] ~~(Added)~~ The method for producing lactic acid/lactic acid ester according to any one of claims ~~10~~ 1 to ~~14~~5, wherein the rhenium compound is a compound containing a halide or a carbonyl ligand.

[Claim 7~~16~~] ~~(Added)~~ The method for producing lactic acid/lactic acid ester according to any one of claims ~~10~~ 1 to ~~15~~6, wherein the solvent further contains a phenolic compound.

[Claim 8~~17~~] ~~(Added)~~ The method for producing lactic acid/lactic acid ester according to any one of claims ~~10~~ 1 to ~~16~~7, wherein heat treatment is performed at 100°C to 300°C.

[Claim 9~~18~~] ~~(Added)~~ The method for producing lactic acid/lactic acid ester according to any one of claims ~~10~~ 1 to ~~17~~8, wherein the carbohydrate-containing raw material is at least one type selected from the group consisting of cellulose, soluble polysaccharides, and monosaccharides.