Conversion products from cellulose include, but are not limited to, e.g., cellobiose; glucose; fructose; mannose; formic acid; levulinic acid; 1,6-anhydro-β,D-glucose; and HMF. Results show that at a given percent catalyst composition for metal salts in the catalyst, product yield depends on process conditions, e.g., dissolution and reaction temperatures as well as reaction time.

While preferred embodiments of the invention have been shown and described herein, many changes and modifications may be made without departing from the invention in its broader aspects. The foregoing abstract is neither intended to define the invention of the application, which is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way. The appended claims are therefore intended to cover all such changes and modifications as fall within the scope of the invention.

We claim:

1. A method for selective conversion of a carbohydrate polymer, to produce a furan product, comprising the step of:

heating a carbohydrate polymer selected from the group consisting of cellulose, hemicellulose, cellobiose, maltodextrin, starch, and combinations thereof in an ionic liquid comprising a 1-R_1-3-R_2-imidazolium halide of chemical formula C_xH_{2x+1}, where R_1 and R_2 are alkyl groups, and where X=1 to 18 at a preselected temperature with a dual-metal catalyst at a selected ratio for a time sufficient to convert said carbohydrate polymer to said furan product.

2. The method of claim **1**, wherein said ionic liquid is selected from the group consisting of: 1-ethyl-3-methylimidazollum chloride ([EMINA]Cl); 1-butyl-3-methylimidazolium chloride ([BMIM]Cl), 1-ethyl-3-methylimidazolium bromide ([EMIM]Br), and combinations thereof.

3. The method of claim **1**, wherein said catalyst comprises $CuCl_2$ and at least one other metal halide.

4. The method of claim **3**, wherein said at least one other metal halide is selected from the group consisting of: $CrCl_2$, $CrCl_3$, $PdCl_2$, $FeCl_3$, $LaCl_3$, $NiCl_2$, $CoCl_2$, and combinations thereof.

5. The method of claim **4**, wherein the at least two metal halides are present at a ratio from about 97:3 to about 50:50 on a percentage basis.

6. The method of claim **1**, further comprising the step of dissolving said carbohydrate polymer in said ionic liquid prior to the step of heating said carbohydrate polymer to decrystalize said carbohydrate polymer.

7. The method of claim **1**, wherein the step of heating includes heating the carbohydrate polymer at a concentration of up to about 30 wt % in said ionic liquid.

8. The method of claim **1**, wherein the carbohydrate polymer is cellulose, the catalyst comprises a preselected ratio of $CuCl_2$ and $CrCl_2$ metal halides, and the carbohydrate product is 5-hydroxylmethylfurfural.

9. The method of claim **1**, wherein said preselected temperature is a temperature selected in the range from about 100° C. to about 180° C. and said preselected time for conversion of said carbohydrate polymer is selected in the range from about 0.01 hours to about 8 hours.

10. A system for conversion of carbohydrate polymers, comprising:

a first metal halide and a second metal halide in preselected ionic liquid.

11. The system of claim **10**, wherein said first metal halide and said second metal halide are selected from the group consisting of: $CuCl_2$, $CrCl_2$, $CrCl_3$, $PdCl_2$, $FeCl_3$, $LaCl_3$, $NiCl_2$, $CoCl_2$, and combinations thereof.

12. The system of claim **10**, wherein said first metal halide and said second metal halide have a ratio preselected in the range from about 95:5 to about 50:50 on a percentage basis.

13. The system of claim **10**, wherein said first metal halide and said second metal halide have a ratio preselected in the range from about 99:1 to about 80:20 on a percentage basis.

14. The system of claim **10**, wherein said first metal halide and said second metal halide comprise a total metal halide concentration in said ionic liquid in the range from 6 mmol/g ionic liquid to about 37 mmol/g ionic liquid.

15. The system of claim **10**, wherein said first metal halide and said second metal halide comprise a total metal halide concentration in said ionic liquid in the range from about 12 mmol/g ionic liquid to about 185 mmol/g ionic liquid.

16. The system of claim **10**, wherein said first metal halide and said second metal halide comprise a total metal halide concentration in said ionic liquid in the range from about 18 mmol/g ionic liquid to about 60 mmol/g ionic liquid.

17. A method for selective conversion of a carbohydrate polymer, comprising the step of:

heating the carbohydrate polymer in an ionic liquid comprising 1-R_1-3-R_2-imidazolium halide wherein R_1 and R_2 are alkyl groups of chemical formula C_xH_{2x+1} where X=1 to 18, with a catalyst comprising a preselected ratio of at least two metal halides at a preselected temperature for a time sufficient to hydrolyze same, forming a preselected carbohydrate monomer product that includes glucose.

18. The method of claim **17**, wherein the first metal halide and second metal halide have a ratio preselected in the range from about 99:1 to about 50:50 on a percentage basis.

19. The method of claim **17**, wherein said first metal halide and said second metal halide comprise a total metal halide concentration in said ionic liquid in the range from 6 mmol/g ionic liquid to about 185 mmol/g ionic liquid.

20. A method for selective conversion of a carbohydrate polymer, comprising the step of:

heating the carbohydrate polymer in an ionic liquid comprised of 1-R_1-3-R_2-imidazolium halide wherein R_1 and R_2 are alkyl groups of chemical formula C_xH_{2x+1} where X=1 to 18, with a catalyst comprising a preselected ratio of at least two metal halides at a preselected temperature for a time sufficient to dehydrate same, forming a preselected carbohydrate dehydration product that includes 5-hydroxylmethylfurfural.

21. The method of claim **20**, wherein the first metal halide and second metal halide have a ratio preselected in the range from about 99:1 to about 50:50 on a percentage basis.

22. The method of claim **20**, wherein said first metal halide and said second metal halide comprise a total metal halide concentration in said ionic liquid in the range from 6 mmol/g ionic liquid to about 185 mmol/g ionic liquid.

23. The method of claim **1**, wherein the furan is 5-hydroxylmethylfurfural.

24. The method of claim **1**, wherein the furan product further includes a member selected from the group consisting of: cellobiose, sorbitol, formic acid, levulinic acid, 1,6-anhydro-β,D-glucose, and combinations thereof.

25. The method of claim **1**, wherein the furan product further includes fructose, glucose, mannose, and combinations thereof.

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