BRIEF SUMMARY

[0006] The present disclosure addresses this need by providing polymeric materials that can be used to digest the hemicellulose and cellulose, including the crystalline domains of cellulose, in biomass. Specifically, the polymeric materials can hydrolyze the cellulose and/or hemicellulose into monosaccharides and/or oligosaccharides.

[0007] The present disclosure provides~~In one aspect, provided is~~ a polymer having acidic monomers and ionic monomers that are connected to form a polymeric backbone, in which each acidic monomer has at least one Bronsted-Lowry acid, and each ionic monomer independently has at least one nitrogen-containing cationic group or phosphorous-containing cationic group. In some embodiments, each acidic monomer has one Bronsted-Lowry acid. In other embodiments, some of the acidic monomers have one Bronsted-Lowry acid, while others have two Bronsted-Lowry acids. In some embodiments, each ionic monomer has one nitrogen-containing cationic group or phosphorous-containing cationic group. In other embodiments, some of the ionic monomers have one nitrogen-containing cationic group or phosphorous-containing cationic group, while others have two nitrogen-containing cationic groups or phosphorous-containing cationic groups.

[0007a] In one aspect of the present disclosure, there is provided a polymer comprising acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group, wherein one or more of the ionic monomers each further comprise a linker connecting the nitrogen-containing cationic group or the phosphorous-containing cationic group to the polymeric backbone, and

wherein the linker of the one or more ionic monomers at each occurrence is independently selected from the group consisting of unsubstituted or substituted alkylene, unsubstituted or substituted cycloalkylene, unsubstituted or substituted alkenylene, unsubstituted or substituted arylene, unsubstituted or substituted heteroarylene, unsubstituted or substituted alkylene ether, and unsubstituted or substituted alkylene carbamate.

[0007b] In another aspect of the present disclosure, there is provided a polymer selected from the group consisting of:

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium nitrate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium nitrate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium iodide-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bromide-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium formate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-nitrate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-chloride-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bromide-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-iodide-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bisulfate-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-acetate-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium formate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-(4-vinylbenzyl)-morpholine-4-oxide-*co*-divinyl benzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium acetate-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-4-boronyl-1-(4-vinylbenzyl)-pyridinium chloride-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium chloride-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium bisulfate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium acetate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium nitrate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-(4-vinylbenzyl)-morpholine-4-oxide-*co*-divinyl benzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenyl phosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenyl phosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenyl phosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenyl phosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenyl phosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenyl phosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene)

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium nitrate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(butyl-vinylimidazolium chloride–*co*–butylimidazolium bisulfate–*co*–4-vinylbenzenesulfonic acid);

poly(butyl-vinylimidazolium bisulfate–*co*–butylimidazolium bisulfate–*co*–4-vinylbenzenesulfonic acid);

poly(benzyl alcohol-*co*-4-vinylbenzylalcohol sulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzyl alcohol); and

poly(benzyl alcohol-*co*-4-vinylbenzylalcohol sulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzyl alcohol).

[0007c] In a further aspect of the present disclosure, there is provided a solid particle comprising a solid core and a polymer coated on the surface of the solid core, wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group.

[0007d] In another aspect of the present disclosure, there is provided a composition comprising:

biomass; and

a polymer, wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group.

[0007e] In a further aspect of the present disclosure, there is provided a chemically-hydrolyzed biomass composition comprising:

a polymer, wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group;

one or more sugars; and

residual biomass.

[0007f] In another aspect of the present disclosure, there is provided a composition comprising:

one or more saccharides; and

a polymer;

wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone, wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or at least one phosphorous-containing cationic group.

[0007g] In a further aspect of the present disclosure, there is provided a saccharification intermediate comprising a polymer hydrogen-bonded to biomass,

wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group, and

wherein the biomass comprises cellulose, hemicellulose or a combination thereof.

[0007h] In another aspect of the present disclosure, there is provided a method for degrading biomass into one or more sugars, comprising:

a) providing biomass;

b) contacting the biomass with a polymer and a solvent for a period of time sufficient to produce a degraded mixture,

wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group, and

wherein the degraded mixture comprises a liquid phase and a solid phase, wherein the liquid phase comprises one or more sugars, and wherein the solid phase comprises residual biomass;

c) isolating at least a portion of the liquid phase from the solid phase; and

d) recovering the one or more sugars from the isolated liquid phase.

[0007i] In a further aspect of the present disclosure, there is provided a method for pretreating biomass before hydrolysis of the biomass to produce one or more sugars, comprising:

a) providing biomass;

b) contacting the biomass with a polymer a solvent for a period of time sufficient to partially degrade the biomass,

wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group; and

c) pretreating the partially degraded biomass before hydrolysis to produce one or more sugars.

[0007j] In another aspect of the present disclosure, there is provided a method of hydrolyzing pretreated biomass to produce one or more sugars, comprising:

a) providing biomass pretreated according to a method disclosed herein; and

b) hydrolyzing the pretreated biomass to produce one or more sugars.

[0007k] In a further aspect of the present disclosure, there is provided a use of a polymer for degrading biomass into one or more monosaccharides, one or more oligosaccharides, or a combination thereof,

wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group.

[0007l] In another aspect of the present disclosure, there is provided a use of a polymer for pretreating biomass before further treatment using one or more methods selected from the group consisting of washing, solvent-extraction, solvent-swelling, comminution, milling, steam pretreatment, explosive steam pretreatment, dilute acid pretreatment, hot water pretreatment, alkaline pretreatment, lime pretreatment, wet oxidation, wet explosion, ammonia fiber explosion, organosolvent pretreatment, biological pretreatment, ammonia percolation, ultrasound, electroporation, microwave, supercritical CO_2, supercritical H_2O, ozone, and gamma irradiation,

wherein the polymer comprises acidic monomers and ionic monomers connected to form a polymeric backbone,

wherein each acidic monomer comprises at least one Bronsted-Lowry acid, and

wherein each ionic monomer independently comprises at least one nitrogen-containing cationic group or phosphorous-containing cationic group.

[0007m] In a further aspect of the present disclosure, there is provided a sugar composition obtained by a method disclosed herein.

[0007n] In another aspect of the present disclosure, there is provided a biofuel composition derived from a sugar composition disclosed herein.

[0007o] In a further aspect of the present disclosure, there is provided a method of preparing a polymer disclosed herein, comprising:

a) providing a starting polymer;

b) reacting the starting polymer with a nitrogen-containing or phosphorous-containing compound to produce an ionic polymer; and

c) reacting the ionic polymer with an acid to produce a polymer disclosed herein.

[0007p] In another aspect of the present disclosure, there is provided a polymer prepared according to a method disclosed herein.

[0007q] In a further aspect of the present disclosure, there is provided a use of a polymer prepared according to a method disclosed herein for degrading biomass into one or more monosaccharides, one or more oligosaccharides, or a combination thereof.

[0007r] In another aspect of the present disclosure, there is provided a use of a polymer prepared according to a method disclosed herein for partially digesting biomass before pretreatment using one or more methods selected from the group consisting of washing, solvent-extraction, solvent-swelling, comminution, milling, steam pretreatment, explosive steam pretreatment, dilute acid pretreatment, hot water pretreatment, alkaline pretreatment, lime pretreatment, wet oxidation, wet explosion, ammonia fiber explosion, organosolvent pretreatment, biological pretreatment, ammonia percolation, ultrasound, electroporation, microwave, supercritical CO_2, supercritical H_2O, ozone, and gamma irradiation.

[0007s] In a further aspect of the present disclosure, there is provided a composition comprising:

one or more saccharides; and

a polymer, wherein the polymer is selected from the group consisting of:

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium nitrate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium nitrate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium iodide-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bromide-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium formate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-nitrate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-chloride-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bromide-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-iodide-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bisulfate-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-acetate-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium formate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-(4-vinylbenzyl)-morpholine-4-oxide-*co*-divinyl benzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium acetate-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-4-boronyl-1-(4-vinylbenzyl)-pyridinium chloride-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium chloride-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium bisulfate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium acetate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium nitrate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-(4-vinylbenzyl)-morpholine-4-oxide-*co*-divinyl benzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenyl phosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenyl phosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenyl phosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenyl phosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenyl phosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenyl phosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene)

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium nitrate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(butyl-vinylimidazolium chloride–*co*–butylimidazolium bisulfate–*co*–4-vinylbenzenesulfonic acid);

poly(butyl-vinylimidazolium bisulfate–*co*–butylimidazolium bisulfate–*co*–4-vinylbenzenesulfonic acid);

poly(benzyl alcohol-*co*-4-vinylbenzylalcohol sulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzyl alcohol); and

poly(benzyl alcohol-*co*-4-vinylbenzylalcohol sulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzyl alcohol).

[0008] In some embodiments, the Bronsted-Lowry acid at each occurrence is independently selected from sulfonic acid, phosphonic acid, acetic acid, isophthalic acid, boronic acid, and perfluorinated acid. In certain embodiments, the Bronsted-Lowry acid at each occurrence is independently sulfonic acid or phosphonic acid. In one embodiment, the Bronsted-Lowry acid at each occurrence is sulfonic acid.

[0009] In some embodiments, the one or more of the acidic monomers are directly connected to the polymeric backbone. In other embodiments, the one or more of the acidic monomers each further include a linker connecting the Bronsted-Lowry acid to the polymeric backbone. In certain embodiments, some of the the Bronsted-Lowry acids are directly connected to the polymeric backbone, while other the Bronsted-Lowry acids are connected to the polymeric backbone by a linker.

[0010] In those embodiments where the Bronsted-Lowry acid is connected to the polymeric backbone by a linker, the linker at each occurrence is independently selected from unsubstituted or substituted alkylene, unsubstituted or substituted cycloalkylene, unsubstituted or substituted alkenylene, unsubstituted or substituted arylene, unsubstituted or substituted heteroarylene, unsubstituted or substituted alkylene ether, unsubstituted or substituted alkylene ester, and unsubstituted or substituted alkylene carbamate. In certain embodiments, the linker is

119. A method of hydrolyzing pretreated biomass to produce one or more sugars, comprising:

a) providing biomass pretreated according to any one of claims 116 to 118; and

b) hydrolyzing the pretreated biomass to produce one or more sugars.

120. The method of claim 119, wherein the pretreated biomass is chemically hydrolyzed or enzymatically hydrolyzed.

121. The method of claim 119 or 120, wherein the one or more sugars are selected from the group consisting of glucose, galactose, fructose, xylose, and arabinose.

122. The method of any one of claims 100 to 121, wherein the Bronsted-Lowry acid at each occurrence in the polymer is independently selected from the group consisting of sulfonic acid, phosphonic acid, acetic acid, isophthalic acid, boronic acid, and perfluorinated acid.

123. The method of any one of claims 100 to 122, wherein the nitrogen-containing cationic group in the polymer at each occurrence is independently selected from the group consisting of pyrrolium, imidazolium, pyrazolium, oxazolium, thiazolium, pyridinium, pyrimidinium, pyrazinium, pyradizinium, thiazinium, morpholinium, piperidinium, piperizinium, and pyrollizinium; and

wherein the phosphorous-containing cationic group in the polymer at each occurrence is independently selected from the group consisting of triphenyl phosphonium, trimethyl phosphonium, triethyl phosphonium, tripropyl phosphonium, tributyl phosphonium, trichloro phosphonium, and trifluoro phosphonium.

124. The method of any one of claims 100 to 123, wherein one or more of the acidic monomers in the polymer each further comprise a linker connecting the Bronsted-Lowry acid to the polymeric backbone.

125. The method of any one of claims 100 to 124, wherein one or more of the ionic monomers of the polymer each further comprise a linker connecting the nitrogen-containing cationic group or the phosphorous-containing cationic group to the polymeric backbone.

167. The polymer of claim 166, wherein the polymer has one or more catalytic properties selected from the group consisting of:

a) disruption of a hydrogen bond in cellulosic materials;

b) intercalation of the polymer into crystalline domains of cellulosic materials; and

c) cleavage of a glycosidic bond in cellulosic materials.

168. Use of a polymer prepared according to the method of any one of claims 161 to 165 for degrading biomass into one or more monosaccharides, one or more oligosaccharides, or a combination thereof.

169. Use of a polymer prepared according to the method of any one of claims 161 to 165 for partially digesting biomass before pretreatment using one or more methods selected from the group consisting of washing, solvent-extraction, solvent-swelling, comminution, milling, steam pretreatment, explosive steam pretreatment, dilute acid pretreatment, hot water pretreatment, alkaline pretreatment, lime pretreatment, wet oxidation, wet explosion, ammonia fiber explosion, organosolvent pretreatment, biological pretreatment, ammonia percolation, ultrasound, electroporation, microwave, supercritical CO_2, supercritical H_2O, ozone, and gamma irradiation.

170. A composition comprising:

one or more saccharides; and

a polymer, wherein the polymer is selected from the group consisting of:

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium nitrate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-ethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium nitrate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium iodide-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bromide-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-benzoimidazol-1-ium formate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-acetate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-nitrate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-chloride-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bromide-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-iodide-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-bisulfate-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-(4-vinylbenzyl)-pyridinium-acetate-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-methyl-4-(4-vinylbenzyl)-morpholin-4-ium formate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triphenyl-(4-vinylbenzyl)-phosphonium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-1-methyl-1-(4-vinylbenzyl)-piperidin-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-(4-vinylbenzyl)-morpholine-4-oxide-*co*-divinyl benzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-triethyl-(4-vinylbenzyl)-ammonium acetate-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-4-boronyl-1-(4-vinylbenzyl)-pyridinium chloride-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium chloride-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium bisulfate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium acetate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-3-methyl-1-(4-vinylbenzyl)-3H-imidazol-1-ium nitrate-*co*-1-(4-vinylphenyl)methylphosphonic acid-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium chloride-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylchloride-*co*-1-methyl-2-vinyl-pyridinium acetate-*co*-divinylbenzene];

poly[styrene-*co*-4-vinylbenzenesulfonic acid-*co*-4-(4-vinylbenzyl)-morpholine-4-oxide-*co*-divinyl benzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly [styrene-*co*-4-vinylphenylphosphonic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-3-carboxymethyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-5-(4-vinylbenzylamino)-isophthalic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium chloride-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium bisulfate-*co*-divinylbenzene];

poly[styrene-*co*-(4-vinylbenzylamino)-acetic acid-*co*-3-methyl-1-(4-vinylbenzyl)-3*H*-imidazol-1-ium acetate-*co*-divinylbenzene];

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenyl phosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenyl phosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenyl phosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenyl phosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenyl phosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenyl phosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium chloride-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium bisulfate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-co-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylmorpholinium acetate-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene)

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylmethylimidazolium nitrate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzylmethylimidazolium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenesulfonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzene);

poly(styrene-*co*-4-vinylbenzenephosphonic acid-*co*-vinylbenzyltriphenylphosphonium acetate-*co*-divinylbenzene);

poly(butyl-vinylimidazolium chloride–*co*–butylimidazolium bisulfate–*co*–4-vinylbenzenesulfonic acid);

poly(butyl-vinylimidazolium bisulfate–*co*–butylimidazolium bisulfate–*co*–4-vinylbenzenesulfonic acid);

poly(benzyl alcohol-*co*-4-vinylbenzylalcohol sulfonic acid-*co*-vinylbenzyltriphenylphosphonium chloride-*co*-divinylbenzyl alcohol); and

poly(benzyl alcohol-*co*-4-vinylbenzylalcohol sulfonic acid-*co*-vinylbenzyltriphenylphosphonium bisulfate-*co*-divinylbenzyl alcohol).

171. The composition of claim 170, wherein the one or more saccharides are one or more monosaccharides, or one or more oligosaccharides, or a mixture thereof.

172. The composition of claim 170, wherein the one or more saccharides are two or more saccharides, wherein at least one of the two or more saccharides is a C4-C6 monosaccharide, and at least one of the two or more saccharides is an oligosaccharide.

173. The composition of claim 170, wherein the one or more saccharides are selected from the group consisting of glucose, galactose, fructose, xylose, mannose, and arabinose.

174. The composition of claim 170, wherein the one or more saccharides are one or more monosaccharides.

175. The composition of claim 170, wherein the one or more saccharides are one or more oligosaccharides.