bath from the reaction vessel at an etchant bath removal rate; wherein the first and second replenishment feed rates and the etchant bath removal rate are determined based at least in part on a rate that metal etched from the substrate enters the etchant bath, wherein either or both of the first and second replenishment feed rates are further determined based at least in part on a rate at which the collected rinse is recycled to the reactor vessel.

[0003] A method for processing a substrate is also provided. The method may include providing a substrate and passing the substrate through a reaction vessel. The substrate may include a reactable surface composition and the reaction bath may include a first reaction agent and a second reaction agent. The method may further include contacting the reactable surface composition with the first and second reaction agents to carry out a reaction therebetween and maintaining the concentrations of the first and second reaction agents in the reaction bath by delivering a replenishment feed of each of the first and section reaction agents to the reaction bath. The first and section reaction agents may be delivered to the reaction bath at a first replenishment feed rate and a second replenishment feed rate, respectively. The first and second replenishment feed rates may be determined based at least in part on a rate that the substrate is transported through the reaction vessel.

[0003a] In a second aspect, there is provided a method of processing a substrate comprising: providing a continuous web substrate comprising a surface composition capable of reacting and/or solubilizing in a reaction bath containing one or more reaction agents; passing the substrate through a reaction vessel, wherein the reaction vessel comprises: a reaction bath comprising a first reaction agent and a second reaction agent; contacting the surface composition with the first and second reaction agents to carry out a reaction therebetween; following contacting of the surface composition with the first and second reaction agents: (i) rinsing the substrate web; (ii) collecting the rinse; and (iii) recycling at least a portion of the collected rinse to the reaction bath; and maintaining the concentrations of the first and second reaction agents in the reaction bath by delivering a replenishment feed of each of the first and second reaction agents to the reaction bath, wherein the first and second reaction agents are delivered to the reaction bath at a first replenishment feed rate and a second replenishment feed rate, respectively; and wherein the first and second replenishment feed rates are determined based at least in part on a rate that the substrate is transported through the reaction vessel; wherein the web surface composition comprises metal, and wherein the method further comprises maintaining a concentration of the metal in the reaction bath by discharging an amount of the reaction bath from the reaction vessel at a reaction bath removal rate, and wherein the reaction bath removal rate is determined based at least in part on the rate that the substrate is transported

through the reaction vessel; and wherein either or both of the first and second replenishment feed rates are further determined based at least in part on a rate at which the collected rinse is recycled to the reaction bath.

[0004] The above summary of the present disclosure is not intended to describe each embodiment of the present disclosure. The details of one or more embodiments of the

What is Claimed is:

1. A method of patterning a substrate comprising:

providing a substrate comprising a continuous web having a metalized surface having an etch resist patterned region and an unpatterned region;

passing the substrate web through a reaction vessel, wherein the reaction vessel comprises:

an etchant bath comprising an oxidizing agent and a metal complexing agent;

wet etching the substrate within the reaction vessel by contacting the metalized surface with the oxidizing and metal complexing agents to remove metal from the unpatterned region;

after wet etching the substrate: (i) rinsing the wet etched substrate with a first rinse of water; (ii) collecting the rinse; (iii) recycling at least a portion of the collected rinse to the ethchant bath;

maintaining the concentrations of the oxidizing and metal complexing agents in the etchant bath by delivering a replenishment feed of each of the oxidizing and metal complexing agents to the etchant bath at a first replenishment feed rate and a second replenishment feed rate, respectively; and

maintaining the concentration of the metal in the etchant bath by discharging an amount of the etchant bath from the reaction vessel at an etchant bath removal rate;

wherein the first and second replenishment feed rates and the etchant bath removal rate are determined based at least in part on a rate that metal etched from the substrate enters the etchant bath,

wherein either or both of the first and second replenishment feed rates are further determined based at least in part on a rate at which the collected rinse is recycled to the reactor vessel.

2. The method of claim 1, wherein either or both of the first and second replenishment feed rates are further determined based at least in part on a rate of consumption of the oxidizing and metal complexing agents in either or both of: (i) an etch reaction; and (ii) one or more side reactions occurring among components of the etchant bath.

~~3. The method of claim 1, wherein either or both of the first and second replenishment feed rates are further determined based at least in part on a rate at which the collected rinse is recycled to the reactor vessel.~~

43. The method of ~~any one of the preceding~~ claims 1 or 2, wherein a volume of the etchant bath is maintained substantially constant.

~~54~~. The method of any one of the preceding claims, wherein the oxidizing agent comprises ferric nitrate.

~~65~~. The method of any one of the preceding claims, wherein the metal complexing agent comprises thiourea or a thiourea derivative.

~~76~~. The method of claim 1, wherein the etchant bath comprises a bleach-fix solution.

~~87~~. The method of claim ~~76~~, wherein the oxidizing agent comprises a ferric salt of an aminopolycarboxylic acid.

~~98~~. The method of claim ~~76~~, wherein the metal complexing agent comprises a thiosulfate.

~~09~~. The method of any one of the preceding claims, wherein the metal comprises one or more metals selected from the group consisting of silver, gold, and combinations thereof.

~~1110~~. The method of any one of the preceding claims, wherein the patterned region comprises a self-assembled monolayer patterned region.

~~1211~~. The method of claim ~~1110~~, wherein the self-assembled monolayer patterned region is microcontact printed onto the metalized surface.

~~1312~~. The method of any one of claims ~~1110~~-~~1211~~, wherein the monolayer comprises an organosulfur compound.

~~1413~~. A method of processing a substrate comprising:

providing a continuous web substrate comprising a surface composition capable of reacting and/or solubilizing in a reaction bath containing one or more reaction agents;

passing the substrate through a reaction vessel, wherein the reaction vessel comprises:

a reaction bath comprising a first reaction agent and a second reaction agent;

contacting the surface composition with the first and second reaction agents to carry out a reaction therebetween;

following contacting of the surface composition with the first and second reaction agents: (i) rinsing the substrate web; (ii) collecting the rinse; and (iii) recycling at least a portion of the collected rinse to the reaction bath; and

maintaining the concentrations of the first and second reaction agents in the reaction bath by delivering a replenishment feed of each of the first and second reaction agents to the reaction bath,

wherein the first and second reaction agents are delivered to the reaction bath at a first replenishment feed rate and a second replenishment feed rate, respectively; and

wherein the first and second replenishment feed rates are determined based at least in part on a rate that the substrate is transported through the reaction vessel;

wherein the web surface composition comprises metal, and wherein the method further comprises maintaining a concentration of the metal in the reaction bath by discharging an amount of the reaction bath from the reaction vessel at a reaction bath removal rate, and wherein the reaction bath removal rate is determined based at least in part on the rate that the substrate is transported through the reaction vessel; and

wherein either or both of the first and second replenishment feed rates are further determined based at least in part on a rate at which the collected rinse is recycled to the reaction bath.

~~15. The method of claim 14, wherein the web surface composition comprises metal, and wherein the method further comprises maintaining a concentration of the metal in the reaction bath by discharging an amount of the reaction bath from the reaction vessel at a reaction bath removal rate, and wherein the reaction bath removal rate is determined based at least in part on the rate that the substrate is transported through the reaction vessel.~~

~~16. The method of claim 15, wherein either or both of the first and second replenishment feed rates are further determined based at least in part on a rate at which the collected rinse is recycled to the reactor bath.~~

~~17~~14. The method of claim 1 in which the oxidizing and metal complexing agent replenishment feed rates, the etchant bath removal rate and the recycle rate are controlled to maintain concentration of metal from the metalized surface in the etchant bath below the concentration at which metal precipitates onto the substrate web.

~~18~~15. The method of claim 1 which operates at steady state conditions.