CLAIMS

1. A chemical-mechanical polishing pad comprising a thermosetting polyurethane polishing layer, the thermosetting polishing layer comprising:

an isocyanate-terminated urethane prepolymer,~~;~~ wherein the prepolymer has a Shore D hardness in a range from about 75 to about 80;

a polyamine curative; and

a cyclohexanedimethanol curative;

wherein the polyamine curative and the cyclohexanedimethanol curative are in a molar ratio of polyamine curative to cyclohexanedimethanol curative in a range from about 20:1 to about 1:1.

2. The polishing pad of claim 1, wherein the prepolymer is a reaction product of a toluene diisocyanate (TDI) compound or a methylenediphenyl diisocyanate (MDI) compound and polytetramethylene ether glycol (PTMEG) or polypropylene ether glycol.

~~3. The polishing pad of claim 1, wherein the prepolymer is an aromatic prepolymer selected from the group consisting of 75D prepolymers, 80D prepolymers, and mixtures thereof.~~

3~~4~~. The polishing pad of claim 1, wherein the polyamine curative is an aromatic diamine curative selected from the group consisting of aniline diamine compounds, toluene diamine compounds, aminobenzoate compounds, and mixtures thereof.

4~~5~~. The polishing pad of claim 3~~4~~, wherein the aromatic diamine curative is selected from the group consisting of 4,4-methylenebis(2chloroaniline), dimethylthiotoluenediamine, and mixtures thereof.

5~~6~~. The polishing pad of claim 1, wherein the molar ratio of polyamine curative to cyclohexanedimethanol curative is in a range from about 10:1 to about 1.5:1.

6~~7~~. The polishing pad of claim 1, wherein the thermosetting polyurethane polishing layer comprises surface asperities and wherein the surface asperities have a ratio of a storage

modulus at 25 degrees C to a storage modulus at 75 degrees C in a range from about 3 to about 20.

7~~8~~. The polishing pad of claim 6~~7~~, wherein:

the isocyanate-terminated urethane prepolymer includes a 75D prepolymer; and

the surface asperities have a storage modulus (E') at 25 degrees C greater than about 500 MPa and a Shore D hardness at 25 degrees C greater than about 60.

8~~9~~. The polishing pad of claim 7~~8~~, wherein the surface asperities have a tensile toughness at 25 degrees C greater than about 100 MPa.

9~~10~~. The polishing pad of claim 6~~7~~, wherein:

the isocyanate-terminated urethane prepolymer includes an 80D prepolymer; and

the surface asperities have a storage modulus (E') at 25 degrees C greater than about 1000 MPa and a Shore D hardness at 25 degrees C greater than about 70.

10~~11~~. The polishing pad of claim 9~~10~~, wherein the surface asperities have a tensile toughness at 25 degrees C greater than about 50 MPa.

11~~12~~. The polishing pad of claim 1, wherein the thermosetting polyurethane polishing layer further comprises a sufficient quantity of hollow microspheres such that the thermosetting polyurethane polishing layer has a porosity in a range from about 10 to about 50 percent.

12~~13~~. The polishing pad of claim 1, wherein:

~~the prepolymer is an aromatic prepolymer selected from the group consisting of 75D prepolymers, 80D prepolymers, and mixtures thereof;~~

the polyamine curative is an aromatic diamine curative selected from the group consisting of 4,4-methylenebis(2chloroaniline), dimethylthiotoluenediamine, and mixtures thereof; and

the molar ratio of polyamine curative to cyclohexanedimethanol curative is in a range from about 10:1 to about 1.5:1.

13~~14~~. The polishing pad of claim 1, wherein the thermosetting polyurethane polishing layer is adhered to a sub-pad.

14~~15~~. A chemical-mechanical polishing pad comprising a thermosetting polyurethane polymer polishing layer, the thermosetting polishing layer comprising:

an isocyanate-terminated urethane prepolymer, wherein the prepolymer has a Shore D hardness in a range from about 75 to about 80; and

a curative mixture comprising a polyamine curative and a cyclohexanedimethanol curative, wherein the curative mixture comprises from about 5 to about 50 mole percent of the cyclohexanedimethanol curative.

15~~16~~. The polishing pad of claim 14~~15~~, wherein the prepolymer is a reaction product of a toluene diisocyanate (TDI) compound or a methylenediphenyl diisocyanate (MDI) compound and polytetramethylene ether glycol (PTMEG) or polypropylene ether glycol.

~~17. The polishing pad of claim 15, wherein the prepolymer is an aromatic prepolymer selected from the group consisting of 75D prepolymers, 80D prepolymers, and mixtures thereof.~~

16~~18~~. The polishing pad of claim 14~~15~~, wherein the polyamine curative is an aromatic diamine curative selected from the group consisting of aniline diamine compounds, toluene diamine compounds, aminobenzoate compounds, and mixtures thereof.

17~~19~~. The polishing pad of claim 16~~18~~, wherein the aromatic diamine curative is selected from the group consisting of 4,4-methylenebis(2chloroaniline), dimethylthiotoluenediamine, and mixtures thereof.

18~~20~~. The polishing pad of claim 14~~15~~, wherein the curative mixture comprises from about 10 to about 40 weight percent of the cyclohexanedimethanol curative.

19~~21~~. The polishing pad of claim 14~~15~~, wherein the curative mixture consists of the polyamine curative and the cyclohexanedimethanol curative.

2022. The polishing pad of claim 1415, wherein the thermosetting polyurethane polishing layer comprises surface asperities and wherein the surface asperities have a ratio of a storage modulus at 25 degrees C to a storage modulus at 75 degrees C in a range from about 3 to about 20.

2123. The polishing pad of claim 2022, wherein:

the isocyanate-terminated urethane prepolymer includes a 75D prepolymer; and

the surface asperities have a storage modulus (E') at 25 degrees C greater than about 500 MPa and a Shore D hardness at 25 degrees C greater than about 60.

2224. The polishing pad of claim 2123, wherein the surface asperities have a tensile toughness at 25 degrees C greater than about 100 MPa.

2325. The polishing pad of claim 2022, wherein:

the isocyanate-terminated urethane prepolymer includes an 80D prepolymer; and

the surface asperities have a storage modulus (E') at 25 degrees C greater than about 1000 MPa and a Shore D hardness at 25 degrees C greater than about 70.

2426. The polishing pad of claim 2325, wherein the surface asperities have a tensile toughness at 25 degrees C greater than about 50 MPa.

2527. The polishing pad of claim 1415, wherein the thermosetting polyurethane polishing layer further comprises a sufficient quantity of hollow microspheres such that the thermosetting polyurethane polishing layer has a porosity in a range from about 10 to about 50 percent.

2628. The polishing pad of claim 1415, wherein:

~~the prepolymer is an aromatic prepolymer selected from the group consisting of 75D prepolymers, 80D prepolymers, and mixtures thereof;~~

the polyamine curative is an aromatic diamine curative selected from the group consisting of 4,4-methylenebis(2chloroaniline), dimethylthiotoluenediamine, and mixtures thereof; and

the curative mixture comprises from about 10 to about 40 weight percent of the cyclohexanedimethanol curative.

2729. The polishing pad of claim 1415, wherein the thermosetting polyurethane polishing layer is adhered to a sub-pad.

2830. A method for fabricating a thermosetting polishing pad, the method comprising:

(a) admixing (i) an isocyanate-terminated urethane prepolymer, wherein the prepolymer has a Shore D hardness in a range from about 75 to about 80; (ii) a polyamine curative; and (iii) a cyclohexanedimethanol curative, wherein the polyamine ~~diamine~~ curative and the cyclohexanedimethanol curative are in a molar ratio of diamine curative to cyclohexanedimethanol curative in a range from about 20:1 to about 1:1 to obtain a mixture;

(b) heating the mixture in a mold to obtain a pre-cured pad; and

(c) curing the pre-cured pad to obtain a polishing pad.

2931. The method of claim 2830, further comprising:

(d) machining the polishing pad to remove a mold skin and to obtain a polishing pad having a desired thickness.

3032. The method of claim 2931, further comprising:

(e) adhering the polishing pad to a sub-pad to obtain a multi-layer polishing pad.

3133. The method of claim 2830, wherein:

~~the prepolymer is an aromatic prepolymer selected from the group consisting of 75D prepolymers, 80D prepolymers, and mixtures thereof;~~

the polyamine curative is an aromatic diamine curative selected from the group consisting of 4,4-methylenebis(2chloroaniline), dimethylthiotoluenediamine, and mixtures thereof; and

the molar ratio of polyamine curative to cyclohexanedimethanol curative is in a range from about 10:1 to about 1.5:1.

3234. A method of chemical mechanical polishing a semiconductor substrate, the method comprising:

(a) contacting the substrate with a polishing pad and a polishing composition, the polishing pad having a thermosetting polishing layer comprising (i) an isocyanate-terminated urethane prepolymer, wherein the prepolymer has a Shore D hardness in a range from about 75 to about 80; (ii) a polyamine curative; and (iii) a cyclohexanedimethanol curative, wherein the polyamine ~~diamine~~ curative and the cyclohexanedimethanol curative are in a molar ratio of polyamine curative to cyclohexanedimethanol curative in a range from about 20:1 to about 1:1;

(b) moving the polishing pad relative to the substrate; and

(c) abrading the substrate to remove a portion of a layer from the substrate and thereby polish the substrate.

3335. The method of claim 3234, wherein:

~~the prepolymer is an aromatic prepolymer selected from the group consisting of 75D prepolymers, 80D prepolymers, and mixtures thereof;~~

the polyamine curative is an aromatic diamine curative selected from the group consisting of 4,4-methylenebis(2chloroaniline), dimethylthiotoluenediamine, and mixtures thereof; and

the molar ratio of polyamine curative to cyclohexanedimethanol curative is in a range from about 10:1 to about 1.5:1.