POLYURETHANES, POLISHING ARTICLES AND POLISHING SYSTEMS THEREFROM AND METHOD OF USE THEREOF

Field of the Disclosure

The present disclosure relates to polyurethane materials and articles containing such materials.

Background

Polyurethane synthesis and film fabrication are described in, for example, U. S. Pat. Publ. 2020/0277517 and U.S. Pat. No. 10,590,303. Use of polyurethane films in polishing articles is described in, for example, U.S. Pat. Nos. 10,071,461 and 10,252,396.

Summary

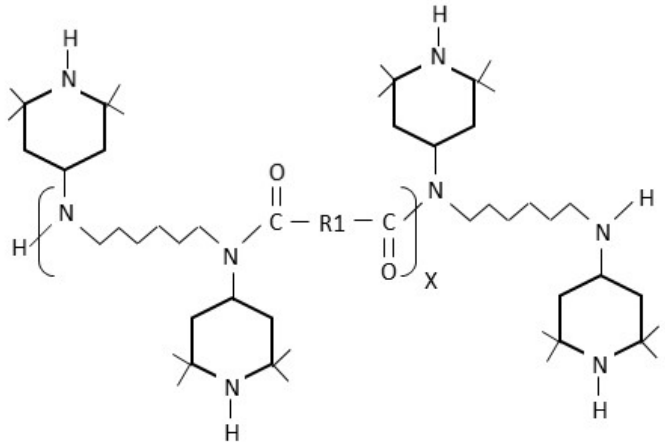
In one aspect, there is provided a polyurethane comprising a reaction product of a reactive mixture including,

a polyol having a number average molecular weight of at least 400 Daltons;

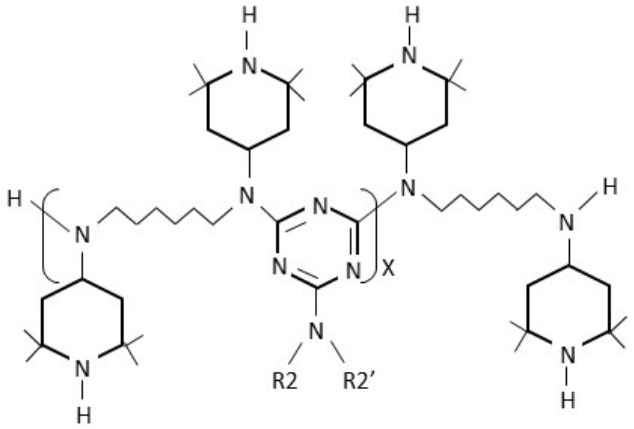
a diol chain extender having a molecular weight less than 400 Daltons;

a diisocyanate; and

a multifunctional amine containing at least two hindered secondary amines according to at least one of Formula I and Formula II



Formula I



Formula II

wherein,

X is an integer from 0 to 10, inclusive of the endpoints,

R1 is a linear or branched aliphatic group, cyclic aliphatic group, aromatic group or a compound containing an aromatic group having from 2 to 20 carbon atoms,

R2 is a linear or branched alkyl group having from 1 to 20 carbon atoms, and

R2' is hydrogen or a linear or branched alkyl group having from 1 to 20 carbon atoms, wherein the amount of multifunctional amine in the reactive mixture is greater than 2 percent by wt. and less than 15 percent by wt. based on the total weight of the reactive mixture.

In another aspect, there is provided a polishing pad comprising a polishing layer having a working surface and a second surface opposite the working surface, wherein the polishing layer includes the polyurethane as defined herein.

Brief Description of the Figures

The disclosure may be more completely understood in consideration of the following detailed description of various embodiments of the disclosure in connection with the accompanying figures, in which:

FIG. 1 is a schematic cross-sectional diagram of a portion of a polishing layer in accordance with some embodiments of the present disclosure.

FIG. 2 is a schematic cross-sectional diagram of a polishing pad in accordance with some embodiments of the present disclosure.

FIG. 3 illustrates a schematic diagram of an example of a polishing system for utilizing the polishing pads and methods in accordance with some embodiments of the present disclosure.

Detailed Description

Polyurethanes are versatile resins that are, generally, synthesized from mixtures of polyols, i.e. an organic compound having at least two alcohol functional groups, and polyisocyanates. i.e. an organic compound having at least two isocyanate functional groups. In addition to these components, other

compounds may be added during synthesis including chain extenders, chain termination agents, crosslinkers, catalysts and the like. Both thermoplastic and thermoset polyurethanes are readily synthesized and, due to the large breadth in the compounds that may be used for their synthesis, a wide range of material properties may be achieved. Due to their toughness, abrasion resistance and chemical resistance, polyurethanes are often used as protective coatings and films.

One area where polyurethane films have recently been employed is as abrasive materials for various polishing applications, for example, Chemical Mechanical Planarization (CMP) polishing applications. In a typical CMP application, a surface of a substrate, e.g. a semiconductor wafer, is brought into contact with a surface of a polishing pad, often in the presence of a working liquid. The substrate is moved relative to the pad under a designated force or pressure, causing removal of material from the substrate surface. The polishing pad often has multiple layers including a polishing layer, i.e. the layer of the pad that contacts the substrate, and a subpad. The design of the polishing layer is critical

What is claimed is:

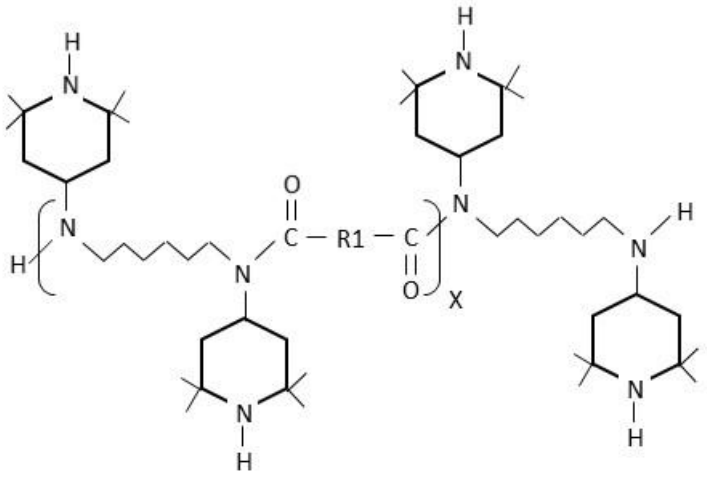
1. A polyurethane comprising a reaction product of a reactive mixture including,

a polyol having a number average molecular weight of at least 400 Daltons;

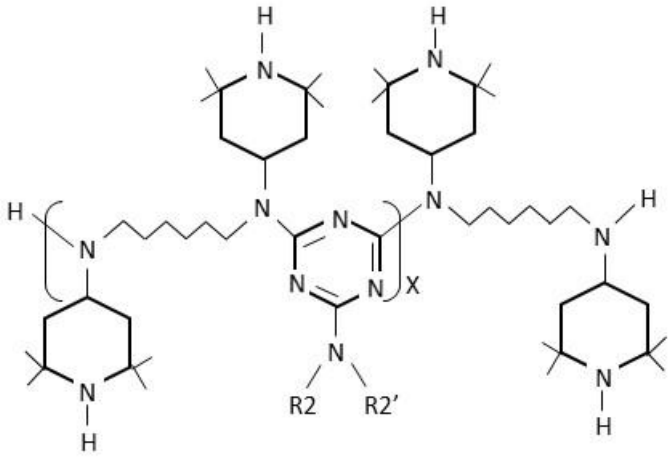
a diol chain extender having a molecular weight less than 400 Daltons;

a diisocyanate; and

a multifunctional amine containing at least two hindered secondary amines according to at least one of Formula I and Formula II



Formula I



Formula II

wherein,

X is an integer from 0 to 10, inclusive of the endpoints,

R1 is a linear or branched aliphatic group, cyclic aliphatic group, aromatic group or a compound containing an aromatic group having from 2 to 20 carbon atoms,

R2 is a linear or branched alkyl group having from 1 to 20 carbon atoms, and
R2' is hydrogen or a linear or branched alkyl group having from 1 to 20 carbon atoms,

wherein the amount of multifunctional amine in the reactive mixture is greater than 2 percent by wt. and less than 15 percent by wt. based on the total weight of the reactive mixture.

2. The polyurethane of claim 1, wherein X is an integer from 0 to 3, inclusive of the endpoints.

3. The polyurethane of claim 1 , wherein R1 is a linear aliphatic group having from 2-8 carbon atoms or an aromatic group.

4. The polyurethane of claim 1, wherein R2 is a linear or branched alkyl having from 1 to 10 carbon atoms and R2' is hydrogen.

5. The polyurethane of claim 1, wherein the mole ratio of isocyanate groups to hydroxyl groups and unhindered secondary amine groups, combined, in the reactive mixture is between 0.96 to 1.08.

6. The polyurethane of claim 1, wherein the polyol includes at least 70 wt. % of a polyol having a hydroxyl functionality of two, based on the weight of the polyol in the reactive mixture.

7. The polyurethane of claim 1, wherein the polyol is between 30 wt. % to 80 wt. % based on the weight of the reactive mixture.

8. The polyurethane of claim 1, wherein the polyol includes at least one of a polyester polyol, a polyether polyol, a polycarbonate polyol and a hydroxyl terminated butadiene.

9. The polyurethane of claim 1, wherein the diisocyanate is between 10 wt. % to 60 wt. % based on the weight of the reactive mixture.

10. The polyurethane of claim 1, wherein the diisocyanate includes a diphenylmethane diisocyanate, a reaction product of a diphenylmethane diisocyanate and a hydroxyl terminated, linear oligomer or polymer, toluene diisocyanate, a reaction product of toluene diisocyanate and a hydroxyl terminated, linear oligomer or polymer and combinations thereof.

11. The polyurethane of claim 1, wherein the polyurethane is a thermoplastic polyurethane.

12. The polyurethane of claim 1, wherein the reactive mixture further includes a polyol having at least three hydroxyl groups.

13. A polishing pad comprising a polishing layer having a working surface and a second surface opposite the working surface, wherein the polishing layer includes the polyurethane of claim 1.

14. The polishing pad of claim 13, wherein the working surface includes a land region and at least one of a plurality of precisely shaped pores and a plurality of precisely shaped asperities.