transmittance.

The fourth aspect of the present invention applies a specific resin to the surface on the polishing surface side of the light-transmitting resin member to suppress large variations in light transmittance between the presence and absence of slurry on the surface of the light-transmitting resin member, making it possible to determine the polishing endpoint more accurately.

The first to fourth aspects of the present inventions provide the following.

[1] AAccording to a first aspect of the present invention, there is provided a polishing pad including:

a light-transmitting member; and

a polishing layer, wherein

the polishing layer includes a polishing surface for polishing an object to be polished, and the polishing pad includes a through hole penetrating from the polishing surface to an opposite surface thereof,

the light-transmitting member is arranged so that the light-transmitting member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, and

a water contact angle of a surface on the polishing surface side of the light-transmitting member is 80 degrees or less.

[2] The polishing pad according to [1], whereinIn an embodiment, a surface of the light-transmitting member opposite to the polishing surface has a water contact angle greater than 80 degrees.

[3] AAccording to a second aspect of the present invention, there is provided a polishing pad including: a light-transmitting member; and a polishing layer, wherein

the polishing layer includes a polishing surface for polishing an object to be polished, and the polishing pad includes a through hole penetrating from the polishing surface to an opposite surface thereof,

the light-transmitting member is arranged so that the light-transmitting member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, and

a surface on the polishing surface side of the light-transmitting member is coated with a hydrophilic resin.

~~[4] The polishing pad according to [3], wherein~~In an embodiment, the hydrophilic resin is a resin having an ion-bonding hydrophilic group.

~~[5] The polishing pad according to [4], wherein~~In an embodiment, the resin having an ion-bonding hydrophilic group is a resin having an ion-bonding hydrophilic group in a side chain thereof.

~~[6] The polishing pad according to [4] or [5], wherein~~In an embodiment, in the resin having an ion-bonding hydrophilic group, a cationic moiety of the ion-bonding hydrophilic group is covalently bonded to a monomer constituting the resin and is ion-bonded to an anionic moiety of the ion-bonding hydrophilic group.

~~[7] The polishing pad according to any one of [4] to [6], wherein~~In an embodiment, the ion-bonding hydrophilic group contains an ammonium cation.

~~[8] The polishing pad according to any one of [3] to [7], wherein~~In an embodiment, the resin-coated surface on the polishing surface side of the light-transmitting member has a water contact angle of 50 degrees or less.

~~[9] A~~According to a third aspect of the present invention, there is provided a polishing pad including: a light-transmitting resin member; and a polishing layer, wherein

the polishing layer includes a polishing surface for polishing an object to be polished, and the polishing pad includes a through hole penetrating from the polishing surface to an opposite surface thereof,

the light-transmitting resin member is arranged so that the light-transmitting resin member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, and

the light-transmitting resin member includes a hydrophilic monomer graft-polymerized on a surface on the polishing surface side thereof.

~~[10] The polishing pad according to [9], wherein~~In an embodiment, the surface on the polishing surface side of the light-transmitting resin member has a water contact angle of 80 degrees or less.

~~[11] The polishing pad according to [9] or [10], wherein~~In an embodiment, the hydrophilic monomer is an acrylic monomer.

~~[12] The polishing pad according to [11], wherein~~In an embodiment, the resin with a grafted surface includes an ion complex formed using a complex-forming polymer selected from polyethylene glycol, polyvinylpyrrolidone, polyxylylviologen,

polyethyleneimine, polyvinyl pyridinium chloride, and polyvinyl benzyltrimethylammonium chloride.

~~[13] A~~According to a fourth aspect of the present invention, there is provided a polishing pad including: a light-transmitting resin member; and a polishing layer, wherein

the polishing layer includes a polishing surface for polishing an object to be polished, and the polishing pad includes a through hole penetrating from the polishing surface to an opposite surface thereof,

the light-transmitting resin member is arranged so that the light-transmitting resin member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, and

the light-transmitting resin member includes, at least on a surface on the polishing surface side thereof, a resin containing a structural unit derived from a polyfunctional (meth)acrylate monomer having two or more polymerizable functional groups and having a -C_{2-4} alkylene-O- unit.

~~[14] The polishing pad according to [13], wherein~~In an embodiment, the polyfunctional (meth)acrylate monomer is at least one selected from the group consisting of the following:

a monomer in which a compound having a -C_{2-4} alkylene-O- unit and (meth)acrylic acid are ester-bonded; and

a monomer in which a trihydric or higher alcohol having a C_{2-4} alkylene oxide added thereto and (meth)acrylic acid are ester-bonded.

~~[15] The polishing pad according to [14], wherein~~In an embodiment, the trihydric or higher alcohol is selected from the group consisting of glycerin, diglycerin, triglycerin, trimethylolpropane, ditrimethylolpropane, erythritol, pentaerythritol, and dipentaerythritol.

~~[16] The polishing pad according to any one of [13] to [15], wherein~~In an embodiment, the -C_{2-4} alkylene-O- unit is derived from ethylene oxide and/or propylene oxide.

~~[17] The polishing pad according to any one of [13] to [16], wherein~~In an embodiment, the polyfunctional (meth)acrylate monomer is at least one selected from the group consisting of polyethylene glycol diacrylate, polypropylene glycol diacrylate, ethoxylated pentaerythritol tetraacrylate, propoxylated pentaerythritol tetraacrylate, ethoxylated glycerin triacrylate, propoxylated glycerin triacrylate, ethoxylated trimethylolpropane

triacrylate, and propoxylated trimethylolpropane triacrylate.

~~[18] The polishing pad according to any one of [1] to [17], wherein~~In an embodiment, when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, the surface on the polishing surface side of the light-transmitting resin member is lower than the polishing surface.

~~[19] The polishing pad according to [1] to [18], wherein~~In an embodiment, the polishing surface includes a groove, and when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, a top portion of the light-transmitting member is at the same level as or lower than a bottom portion of the groove.

~~[20] The polishing pad according to any one of [1] to [19], wherein~~In an embodiment,

when the through hole of the polishing layer is a first through hole, the polishing pad further includes an additional layer having a second through hole having a smaller equivalent circle diameter than the first through hole,

the additional layer is located opposite the polishing surface of the polishing layer,

when the polishing pad is viewed in the thickness direction from the polishing surface side, the first through hole and the second through hole at least partially overlap each other, and

the light-transmitting member is arranged so that the light-transmitting member is in the first through hole, when viewed from the polishing surface side of the polishing pad in the thickness direction of the polishing pad.

In addition, the first aspect of the present invention provides ~~the following.~~

~~[1-1] A~~a polishing pad including:

a light-transmitting member; and

a polishing layer, wherein

the polishing layer includes a polishing surface for polishing an object to be polished, and the polishing pad includes a through hole penetrating from the polishing surface to an opposite surface thereof,

the light-transmitting member is arranged so that the light-transmitting member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, and

a water contact angle of a surface on the polishing surface side of the light-

transmitting member is 80 degrees or less.

~~[1-2] The polishing pad according to [1-1], wherein~~In an embodiment, when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, the top portion of the light-transmitting member is lower than the polishing surface.

~~[1-3] The polishing pad according to [1] or [1-2], wherein~~In an embodiment, a surface of the light-transmitting member opposite to the polishing surface has a water contact angle greater than 80 degrees.

~~[1-4] The polishing pad according to any one of [1-1] to [1-3], wherein~~In an embodiment, the visible light transmittance when the light-transmitting member is irradiated with light having a wavelength of 380 nm to 780 nm is 60% or more.

~~[1-5] The polishing pad according to any one of [1-1] to [1-4], wherein~~In an embodiment, the polishing surface has a groove.

~~[1-6] The polishing pad according to [1-5], wherein~~In an embodiment, the groove is an embossed groove.

~~[1-7] The polishing pad according to [1-5] or [1-6], wherein~~In an embodiment, when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, the top portion of the light-transmitting member is at the same level as or lower than a bottom portion of the groove.

~~[1-8] The polishing pad according to any one of [1-1] to [1-7], wherein~~In an embodiment, the through hole has a circular shape when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad.

~~[1-9] The polishing pad according to any one of [1-1] to [1-8], wherein~~In an embodiment,

when the through hole of the polishing layer is a first through hole, the polishing pad further includes an additional layer having a second through hole having a smaller equivalent circle diameter than the first through hole,

the additional layer is located opposite the polishing surface of the polishing layer,

when the polishing pad is viewed in the thickness direction from the polishing surface side, the first through hole and the second through hole at least partially overlap each other, and

the light-transmitting member is arranged so that the light-transmitting member is in the first through hole, when viewed from the polishing surface side of the polishing

pad in the thickness direction of the polishing pad.

~~[1-10] A~~ In an embodiment, there is provided a method for manufacturing the above polishing pad ~~according to any one of [1-1] to [1-9]~~, including the steps of:

preparing a polishing layer and a light-transmitting member having a water contact angle of 80 degrees or less on at least one surface thereof;

providing a through hole in the polishing layer; and

arranging the light-transmitting member so that the light-transmitting member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, where it is arranged so that the one surface of the light-transmitting member faces the polishing surface.

In addition, the second aspect of the present invention provides ~~the following.~~

~~[2-1] A~~a polishing pad including:

a light-transmitting member; and

a polishing layer, wherein

the polishing layer includes a polishing surface for polishing an object to be polished, and the polishing pad includes a through hole penetrating from the polishing surface to an opposite surface thereof,

the light-transmitting member is arranged so that the light-transmitting member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, and

the surface on the polishing surface side of the light-transmitting member is coated with a hydrophilic resin.

~~[2-2] The polishing pad according to [2-1], wherein~~In an embodiment, the hydrophilic resin is a resin having an ion-bonding hydrophilic group.

~~[2-3] The polishing pad according to [2-2], wherein~~In an embodiment, the resin having an ion-bonding hydrophilic group is a resin having an ion-bonding hydrophilic group in a side chain thereof.

~~[2-4] The polishing pad according to [2-2] or [2-3], wherein~~In an embodiment, in the resin having an ion-bonding hydrophilic group, a cationic moiety of the ion-bonding hydrophilic group is covalently bonded to a monomer constituting the resin and is ion-bonded to an anionic moiety of the ion-bonding hydrophilic group.

~~[2-5] The polishing pad according to any one of [2-2] to [2-4], wherein~~In an embodiment,

the ion-bonding hydrophilic group contains an ammonium cation.

[~~2-6] The polishing pad according to any one of [2-1] to [2-5], wherein~~In an embodiment, the resin-coated surface on the polishing surface side of the light-transmitting member has a water contact angle of 50 degrees or less.

~~[2-7] The polishing pad according to any one of [2-1] to [2-6], wherein~~In an embodiment, the polishing surface has a groove.

~~[2-8] The polishing pad according to [2-7], wherein~~In an embodiment, the groove is an embossed groove.

~~[2-9] The polishing pad according to [2-7] or [2-8], wherein~~In an embodiment, when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, the top portion of the light-transmitting member coated with the resin is at the same level as or lower than a bottom portion of the groove.

~~[2-10] The polishing pad according to any one of [2-1] to [2-9], wherein~~In an embodiment, the through hole has a circular shape when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad.

~~[2-11] The polishing pad according to any one of [2-1] to [2-10], wherein~~In an embodiment,

when the through hole of the polishing layer is a first through hole, the polishing pad further includes an additional layer having a second through hole having a smaller equivalent circle diameter than the first through hole,

the additional layer is located opposite the polishing surface of the polishing layer,

when the polishing pad is viewed in the thickness direction from the polishing surface side, the first through hole and the second through hole at least partially overlap each other, and

the light-transmitting member is arranged so that the light-transmitting member is in the first through hole, when viewed from the polishing surface side of the polishing pad in the thickness direction of the polishing pad.

~~[2-12] A~~In an embodiment, there is provided a method for manufacturing the above polishing pad ~~according to any one of [2-1] to [2-11]~~, including the steps of:

preparing a light-transmitting member having at least one surface coated with a hydrophilic resin and a polishing layer;

providing a through hole in the polishing layer; and

arranging the light-transmitting member so that the light-transmitting member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, where it is arranged so that the coating surface of the light-transmitting member faces the polishing surface.

In addition, the third aspect of the present invention provides the following.

~~[3-1] A~~a polishing pad including:

a light-transmitting resin member; and

a polishing layer, wherein

the polishing layer includes a polishing surface for polishing an object to be polished, and the polishing pad includes a through hole penetrating from the polishing surface to an opposite surface thereof,

the light-transmitting resin member is arranged so that the light-transmitting resin member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, and

the light-transmitting resin member includes a hydrophilic monomer graft-polymerized on the surface on the polishing surface side thereof.

~~[3-2] The polishing pad according to [3-1], wherein~~In an embodiment, the surface on the polishing surface side of the light-transmitting resin member has a water contact angle of 80 degrees or less.

~~[3-3] The polishing pad according to [1] or [2], wherein~~In an embodiment, the hydrophilic monomer is an acrylic monomer.

~~[3-4] The polishing pad according to [3-3], wherein~~In an embodiment, the resin with a grafted surface includes an ion complex formed using a complex-forming polymer selected from polyethylene glycol, polyvinylpyrrolidone, polyxylylviologen, polyethyleneimine, and polyvinyl pyridinium chloride.

~~[3-5] The polishing pad according to any one of [3-1] to [3-4], wherein~~In an embodiment, when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, the grafted surface of the light-transmitting resin member is lower than the polishing surface.

~~[3-6] The polishing pad according to any one of [3-1] to [3-5], wherein~~In an embodiment, the polishing surface has a groove.

[3-7] The polishing pad according to [3-6], wherein In an embodiment, the groove is an embossed groove.

[3-8] The polishing pad according to [3-6] or [3-7], wherein In an embodiment, when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, the grafted surface of the light-transmitting resin member is at the same level as or lower than a bottom portion of the groove.

[3-9] The polishing pad according to any one of [3-1] to [3-8], wherein In an embodiment, the through hole has a circular shape when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad.

[3-10] The polishing pad according to any one of [3-1] to [3-9], wherein In an embodiment,

when the through hole of the polishing layer is a first through hole, the polishing pad further includes an additional layer having a second through hole having a smaller equivalent circle diameter than the first through hole,

the additional layer is located opposite the polishing surface of the polishing layer,

when the polishing pad is viewed in the thickness direction from the polishing surface side, the first through hole and the second through hole at least partially overlap each other, and

the light-transmitting resin member is arranged so that the light-transmitting resin member is in the first through hole, when viewed from the polishing surface side of the polishing pad in the thickness direction of the polishing pad.

[3-11] A In an embodiment, there is provided a method for manufacturing the above polishing pad according to any one of [3-1] to [3-10], including the steps of:

preparing a polishing layer and a light-transmitting resin member having at least one surface graft-polymerized with a hydrophilic monomer;

providing a through hole in the polishing layer; and

arranging the light-transmitting resin member so that the light-transmitting resin member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, where it is arranged so that the grafted surface of the light-transmitting resin member faces the polishing surface.

[3-12] The manufacturing method according to [3-11] In an embodiment, the above method further including the step of plasma-grafting the at least one surface of the light-

transmitting resin member.

In addition, the fourth aspect of the present invention provides ~~the following.~~

~~[4-1] A~~a polishing pad including: a light-transmitting resin member; and a polishing layer, wherein

the polishing layer includes a polishing surface for polishing an object to be polished, and the polishing pad includes a through hole penetrating from the polishing surface to an opposite surface thereof,

the light-transmitting resin member is arranged so that the light-transmitting resin member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, and

the light-transmitting resin member includes, at least on the surface on the polishing surface side thereof, a resin containing a structural unit derived from a polyfunctional (meth)acrylate monomer having two or more polymerizable functional groups and having a -C_{2-4} alkylene-O- unit.

~~[4-2] The polishing pad according to [4-1], wherein~~In an embodiment, the polyfunctional (meth)acrylate monomer is at least one selected from the group consisting of the following:

a monomer in which a compound having a -C_{2-4} alkylene-O- unit and (meth)acrylic acid are ester-bonded; and

a monomer in which a trihydric or higher alcohol having a C_{2-4} alkylene oxide added thereto and (meth)acrylic acid are ester-bonded.

~~[4-3] The polishing pad according to [4-2], wherein~~In an embodiment, the trihydric or higher alcohol is selected from the group consisting of glycerin, diglycerin, triglycerin, trimethylolpropane, ditrimethylolpropane, erythritol, pentaerythritol, and dipentaerythritol.

~~[4-4] The polishing pad according to any one of [4-1] to [4-3], wherein~~In an embodiment, the -C_{2-4} alkylene-O- unit is derived from ethylene oxide and/or propylene oxide.

~~[4-5] The polishing pad according to any one of [4-1] to [4-4], wherein~~In an embodiment, the polyfunctional (meth)acrylate monomer is at least one selected from the group consisting of polyethylene glycol diacrylate, polypropylene glycol diacrylate, ethoxylated pentaerythritol tetraacrylate, propoxylated pentaerythritol tetraacrylate, ethoxylated glycerin triacrylate, propoxylated glycerin triacrylate, ethoxylated trimethylolpropane

triacrylate, and propoxylated trimethylolpropane triacrylate.

[4-6] The polishing pad according to any one of [4-1] to [4-5], wherein In an embodiment, when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, the surface on the polishing surface side of the light-transmitting resin member is lower than the polishing surface.

[4-7] The polishing pad according to any one of [4-1] to [4-6], wherein In an embodiment, the polishing surface has a groove.

[4-8] The polishing pad according to [4-7], wherein In an embodiment, the groove is an embossed groove.

[4-9] The polishing pad according to [4-7] or [4-8], wherein In an embodiment, when the polishing surface is an upper surface and the opposite surface thereof is a lower surface, the surface on the polishing surface side of the light-transmitting resin member is at the same level as or higher than a bottom portion of the groove.

[4-10] The polishing pad according to any one of [4-1] to [4-9], wherein In an embodiment, the through hole has a circular shape when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad.

[4-11] The polishing pad according to any one of [4-1] to [4-10], wherein In an embodiment,

when the through hole of the polishing layer is a first through hole, the polishing pad further includes an additional layer having a second through hole having a smaller equivalent circle diameter than the first through hole,

the additional layer is located opposite the polishing surface of the polishing layer,

when the polishing pad is viewed in the thickness direction from the polishing surface side, the first through hole and the second through hole at least partially overlap each other, and

the light-transmitting resin member is arranged so that the light-transmitting resin member is in the first through hole, when viewed from the polishing surface side of the polishing pad in the thickness direction of the polishing pad.

[4-12] A In an embodiment, there is provided a method for manufacturing the above polishing pad according to any one of [4-1] to [4-11], including the steps of:

preparing a polishing layer and a light-transmitting resin member including, on

at least one surface, a resin containing a structural unit derived from a polyfunctional (meth)acrylate monomer having two or more polymerizable functional groups and having a -C_{2-4} alkylene-O- unit;

providing a through hole in the polishing layer; and

arranging the light-transmitting resin member so that the light-transmitting resin member is in the through hole when viewed from the polishing surface side of the polishing pad in a thickness direction of the polishing pad, where it is arranged so that the surface of the light-transmitting resin member having the resin containing a structural unit derived from a polyfunctional (meth)acrylate monomer faces the polishing surface.

Advantageous Effects of Invention

According to the first aspect of the present invention, it is possible to provide a polishing pad that can suppress variations in light transmittance. This makes it possible to determine the polishing endpoint with high accuracy.

According to the second aspect of the present invention, it is possible to provide a polishing pad that can suppress variations in light transmittance. This makes it possible to determine the polishing endpoint with high accuracy.

According to the third aspect of the present invention, it is possible to provide a polishing pad that can reduce adhesion and sticking of polishing swarf to the surface on the polishing surface side of the light-transmitting resin member (window member). This enables stable optical detection.

According to the fourth aspect of the present invention, it is possible to provide a polishing pad that can suppress variations in light transmittance. This makes it possible to determine the polishing endpoint with high accuracy.

Brief Description of Drawings

Fig. 1 is a perspective view of a polishing pad according to an embodiment of