cutting wheel reduces the production efficiency because the cutting process is interrupted. Also scraping of the blade section reduces the lifetime of the cutting wheel. Thus it is preferred to refrain from dressing if possible.

Embodiments~~An object~~ of the invention seek~~is~~ to provide a cemented carbide base outer-diameter blade cutting wheel which can be used over a long term without a need for dressing and suited for cutting a workpiece, typically rare earth sintered magnet block into pieces at a high dimensional accuracy, and a method for preparing the same.

Embodiments of t~~T~~he invention relate~~s~~ to an outer blade cutting wheel comprising a base in the form of an annular thin disc and a blade section on the outer periphery of the base, the blade section comprising abrasive grains and a metal or alloy bond, the metal or alloy bond being deposited on the outer periphery of the base by electroplating or electroless plating for bonding abrasive grains together and to the base. The inventors have found that better results may be~~are~~ obtained when diamond and/or cBN abrasive grains having an average grain size of 45 to 310 μm and a toughness index TI of at least 150 are used as the abrasive grains, and the blade section is formed so as to meet specific geometry and topography conditions. Even when abrasive grains having heat resistance and impact resistance and a toughness index TI of at least 150 are used, the outer blade cutting wheel may continue~~s~~ the cutting operation over a long term while maintaining a high cutting accuracy because of the minimized risk of abrasive grains being fractured, shed or thermally consumed during the cutting operation where the outer blade cutting wheel is exposed to severe impacts.

According to a first~~In one~~ aspect, the invention provides an outer blade cutting wheel comprising a base in the form of an annular thin disc of cemented carbide having a Young's modulus of 450 to 700 GPa, having an outer diameter of 80 to 200 mm defining an outer periphery, an inner diameter of 30 to 80 mm, and a thickness of 0.1 to 1.0 mm, and a blade section disposed on the outer periphery of the base and having a greater

thickness than the base, the blade section comprising abrasive grains and a metal or alloy bond, the metal or alloy bond being deposited on the outer periphery of the base by electroplating or electroless plating for bonding abrasive grains together and to the base. The abrasive grains are diamond and/or cBN abrasive grains having an average grain size of 45 to 310 μm and a toughness index TI of at least 150. The blade section includes overlay portions which each protrude outward beyond the thickness of the base, the thickness of the overlay portion of the blade section meets a tolerance [($T3_{max}$-$T3_{min}$) mm] in the range (1):

$$0.001 \leq T3_{max}-T3_{min} \leq 0.1\times T2_{max} \qquad (1)$$

wherein $T3_{max}$ and $T3_{min}$ are maximum and minimum values of the thickness of the overlay portion throughout the circumference of the blade section, $T2_{max}$ is a maximum value of the thickness of the blade section throughout the circumference of the blade section. The blade section meets a roundness [($OD_{max}/2-OD_{min}/2$) mm] in the range (2):

$$0.001 \leq OD_{max}/2-OD_{min}/2 \leq 0.01\times OD_{max} \qquad (2)$$

wherein OD_{max} and OD_{min} are maximum and minimum values of the outer diameter of the blade section, and wherein said blade section further comprises a metal or alloy binder having a melting point of up to 350°C and after the metal or alloy bond is deposited on the outer periphery of the base by plating for bonding abrasive grains together and to the base, the metal or alloy binder is infiltrated between abrasive grains and between abrasive grains and the base.

According to a second aspect, there is provided an outer blade cutting wheel comprising a base in the form of an annular thin disc of cemented carbide having a Young's modulus of 450 to 700 GPa, having an outer diameter of 80 to 200 mm defining an outer periphery, an inner diameter of 30 to 80 mm, and a thickness of 0.1 to 1.0 mm, and a blade section disposed on the outer periphery of the base and having a greater thickness than the base, said blade section comprising abrasive grains and a metal or alloy bond, the metal or alloy bond being deposited on the outer periphery of the base by electroplating or electroless plating for bonding abrasive grains together and to the base, wherein

said abrasive grains are diamond and/or cBN abrasive grains having an average grain size of 45 to 310 μm and a toughness index TI of at least 150,

said blade section includes overlay portions which each protrude outward beyond the thickness of said base, the thickness of the overlay portion of said blade section has a tolerance [$(T3_{max}-T3_{min})$ mm] in the range (1):

$$0.001 \leq T3_{max}-T3_{min} \leq 0.1 \times T2_{max} \qquad (1)$$

wherein $T3_{max}$ and $T3_{min}$ are maximum and minimum values of the thickness of the overlay portion throughout the circumference of the blade section, $T2_{max}$ is a maximum value of the thickness of the blade section throughout the circumference of the blade section, and

said blade section has a roundness [$(OD_{max}/2-OD_{min}/2)$ mm] in the range (2):

$$0.001 \leq OD_{max}/2-OD_{min}/2 \leq 0.01 \times OD_{max} \qquad (2)$$

wherein OD_{max} and OD_{min} are maximum and minimum values of the outer diameter of the blade section, and wherein said blade section further comprises a thermoplastic resin having a melting point of up to 350°C or a thermosetting resin having a curing temperature of up to 350°C and

after the metal or alloy bond is deposited on the outer periphery of the base by plating for bonding abrasive grains

together and to the base, the thermoplastic resin is infiltrated between abrasive grains and between abrasive grains and the base, or a liquid thermosetting resin composition is infiltrated and cured between abrasive grains and between abrasive grains and the base.

According to a third aspect, there is provided a method for manufacturing an outer blade cutting wheel comprising the steps of:

providing a base in the form of an annular thin disc of cemented carbide having a Young's modulus of 450 to 700 GPa, having an outer diameter of 80 to 200 mm defining an outer periphery, an inner diameter of 30 to 80 mm, and a thickness of 0.1 to 1.0 mm,

providing abrasive grains, and

electroplating or electroless plating a metal or alloy on the base outer periphery for bonding the abrasive grains together and to the base to fixedly secure the abrasive grains to the base outer periphery to form a blade section having a greater thickness than the base,

said method further comprising the steps of:

using diamond and/or cBN abrasive grains having an average grain size of 45 to 310 μm and a toughness index TI of at least 150 as said abrasive grains, and

shaping said blade section such that said blade section includes overlay portions which each protrude outward beyond the thickness of said base, the thickness of the overlay portion of said blade section has a tolerance [$(T3_{max}-T3_{min})$ mm] in the range (1):

$$0.001 \leq T3_{max}-T3_{min} \leq 0.1\times T2_{max} \qquad (1)$$

wherein $T3_{max}$ and $T3_{min}$ are maximum and minimum values of the thickness of the overlay portion throughout the circumference of the blade section, $T2_{max}$ is a maximum value of the thickness of the blade section throughout the circumference of the blade section, and said blade section has a roundness [$(OD_{max}/2-OD_{min}/2)$ mm] in the range (2):

$$0.001 \leq OD_{max}/2-OD_{min}/2 \leq 0.01\times OD_{max} \quad (2)$$

wherein OD_{max} and OD_{min} are maximum and minimum values of the outer diameter of the blade section, and wherein

the method further comprising, after the step of plating a metal or alloy on the outer periphery of the base for bonding abrasive grains together and to the base, the step of letting a metal or alloy binder having a melting point of up to 350°C infiltrate into any voids between abrasive grains and between abrasive grains and the base to form the blade section.

~~In a preferred embodiment, the blade section further~~ comprises a metal or alloy binder having a melting point of up to 350°C. After the metal or alloy bond is deposited on the outer periphery of the base by plating for bonding abrasive grains together and to the base, the metal or alloy binder is infiltrated between abrasive grains and between abrasive grains and the base.

In another preferred embodiment, the blade section further comprises a thermoplastic resin having a melting point of up to 350°C or a thermosetting resin having a curing temperature of up to 350°C. After the metal or alloy bond is deposited on the outer periphery of the base by plating for ~~bonding abrasive grains together and to the base, the~~

~~thermoplastic resin is infiltrated between abrasive grains~~ and between abrasive grains and the base, ~~or~~ a liquid thermosetting resin ~~composition~~ is infiltrated and cured between ~~abrasive~~ grains and between abrasive grains and the ~~base.~~

According to a fourth~~In another~~ aspect, the invention provides a method for manufacturing an outer blade cutting wheel comprising the steps of providing a base in the form of an annular thin disc of cemented carbide having a Young's modulus of 450 to 700 GPa, having an outer diameter of 80 to 200 mm defining an outer periphery, an inner diameter of 30 to 80 mm, and a thickness of 0.1 to 1.0 mm; providing abrasive grains; and electroplating or electroless plating a metal or alloy on the base outer periphery for bonding the abrasive grains together and to the base to fixedly secure the abrasive grains to the base outer periphery to form a blade section having a greater thickness than the base. The method further comprises the steps of using diamond and/or cBN abrasive grains having an average grain size of 45 to 310 μm and a toughness index TI of at least 150 as the abrasive grains; and shaping the blade section such that the blade section includes overlay portions which each protrude outward beyond the thickness of the base, the thickness of the overlay portion of the blade section has a tolerance [$(T3_{max}-T3_{min})$ mm] in the range (1):

$$0.001 \leq T3_{max}-T3_{min} \leq 0.1\times T2_{max} \qquad (1)$$

wherein $T3_{max}$ and $T3_{min}$ are maximum and minimum values of the thickness of the overlay portion throughout the circumference of the blade section, $T2_{max}$ is a maximum value of the thickness of the blade section throughout the circumference of the blade section, and the blade section has a roundness [$(OD_{max}/2-OD_{min}/2)$ mm] in the range (2):

$$0.001 \leq OD_{max}/2-OD_{min}/2 \leq 0.01\times OD_{max} \qquad (2)$$

wherein OD_{max} and OD_{min} are maximum and minimum values of the

outer diameter of the blade section, and wherein the method further comprising, after the step of plating a metal or alloy on the outer periphery of the base for bonding abrasive grains together and to the base, the step of letting a thermoplastic resin having a melting point of up to 350°C infiltrate into any voids between abrasive grains and between abrasive grains and the base to form the blade section, or a liquid thermosetting resin composition having a curing temperature of up to 350°C infiltrate and cure into any voids between abrasive grains and between abrasive grains and the base to form the blade section.

~~The method may further comprise, after the step of~~ plating a metal or alloy on the outer periphery of the base for bonding abrasive grains together and to the base, the step of letting a metal or alloy binder having a melting point of up to 350°C infiltrate into any voids between abrasive grains and between abrasive grains and the base to form the blade section.

Also the method may further comprise, after the step of plating a metal or alloy on the outer periphery of the base for bonding abrasive grains together and to the base, the step of letting a thermoplastic resin having a melting point of up to 350°C infiltrate into any voids between abrasive grains and between abrasive grains and the base to form the blade section, or a liquid thermosetting resin composition having a curing temperature of up to 350°C infiltrate and cure into any voids between abrasive grains and between abrasive grains and the base to form the blade ~~section.~~

ADVANTAGEOUS EFFECTS OF INVENTION

Using the cemented carbide base outer-diameter blade cutting wheel, an article, typically rare earth sintered magnet block can be cut into pieces at a high dimensional accuracy. Since the cutting wheel can be used over a long term without a need for dressing, in cutting of an article into pieces of high accuracy dimensions, the extra steps which are otherwise required to maintain high-accuracy cutting operation can be substantially saved. In extreme cases, the step of inspecting the dimensions of cut pieces may be simplified. Rare earth magnet pieces having a high dimensional accuracy can be~~are~~ obtained at a low cost.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 schematically illustrates an outer blade cutting wheel in one embodiment of the invention, FIG. 1A being a plan view, FIG. 1B being a cross-sectional view taken