WHAT IS CLAIMED IS:

1. A workpiece grinding method of grinding a back surface of a workpiece having, on a front surface thereof, a device region and an outer peripheral surplus region surrounding the device region, to form a recessed portion in the back surface, thereby forming a circular thin plate portion and an annular protrusion portion surrounding the circular thin plate portion, the method comprising:

a holding step of holding the front surface of the workpiece with a holding surface of a chuck table that is rotatable about an axis of a rotary shaft;

a rotary-shaft direction grinding step of grinding the back surface of the workpiece by relatively moving a grinding unit and the chuck table toward each other along the axis of the rotary shaft of the chuck table, the grinding unit including a spindle having a distal end portion to which a grinding wheel is mounted, the grinding wheel including an annular base and a plurality of grinding stones that are arranged in an annular pattern on one surface of the base and that have outer peripheral surfaces defining a circle of a diameter not greater than a radius of the workpiece, wherein the rotary-shaft direction grinding step is performed with a

position of the chuck table adjusted such that a moving path of bottom surfaces of the grinding stones that is formed together with rotation of the spindle and an axis of the chuck table do not overlap each other, whereby a protrusion portion is formed at a central portion on the back surface when a grinding surface is fed for grinding from the back surface to a predetermined target depth; and

a radially directed grinding step of grinding the back surface of the workpiece by relatively moving the grinding unit and the chuck table in a radial direction of the chuck table, the radial direction being orthogonal to the axis, wherein

the radially directed grinding step includes

an inwardly directed grinding step of grinding the workpiece while relatively moving the grinding unit and the chuck table from a position where the moving path of the bottom surfaces of the grinding stones that is formed together with rotation of the spindle and the axis of the chuck table do not overlap each other to a position where the moving path and the axis of the chuck table overlap each other, so that the protrusion portion on a side of the back surface is ground and removed.

2. The workpiece grinding method according to claim 1, wherein,

the radially directed grinding step further includes an outwardly directed grinding step of grinding the workpiece while relatively moving the grinding unit and the chuck table from the position where the moving path and the axis of the chuck table do not overlap each other, and

in the radially directed grinding step, the inwardly directed grinding step and the outwardly directed grinding step are alternately repeated to grind the workpiece.

3. The workpiece grinding method according to claim 1, wherein

in the inwardly directed grinding step, the grinding wheel is moved toward a center of the holding surface from the position where the moving path of the bottom surfaces of the grinding stones and the axis of the chuck table do not overlap each other to the position where the moving path and the axis of the chuck table overlap each other.

4. The workpiece grinding method according to claim 1, wherein,

in the holding step, the workpiece is held with the

holding surface having a planarity of smaller than 10 μm in terms of roughness, and

in the rotary-shaft direction grinding step and the radially directed grinding step, the workpiece held with the holding surface having the planarity is ground.

5. The workpiece grinding method according to claim 4, wherein,

in the rotary-shaft direction grinding step and the radially directed grinding step, the workpiece is ground with an axis of the spindle of the grinding unit arranged in non-parallel with the axis of the chuck table.