TECHNOLOGY OFFER

MACHINE AND PLANT CONSTRUCTION

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Ring lights in high-precision applications

Tool adjustment at nanometer level through heat expansion (IW126)

BACKGROUND

The fine adjustment of tools presents a great challenge in precision manufacturing, e.g. ultra-precision milling. Deviations in the nanometer range already cause considerable quality losses, thus only single-flute tools are usually applied for so-called “fly-cutting”.

SOLUTION

The invention enables the contact-free adjustment of a radial tool position in the nanometer range during a milling operation. This is accomplished by contactless pinpointed heating which produces a localized expansion of the tool holder.

Therefore, two ring lights equipped with infrared light diodes (IR-LED) heat up the front and back of the rotating tool holder exactly where the expansion is desired. Control electronics recognize the exact position and the velocity of the target surface and activate precisely those IR-LEDs in the ring light which overlap with the target surface. Therefore, the rotating target surface is almost continuously exposed to IR radiation. The intensity of the IR-LED is tunable by means of a power circuit.

It has already been demonstrated that a maximum expansion of approx. 1 µm can be reached even with spindle speeds as high as 240 min-1. Trials with higher spindle speeds are currently in progress.

ADVANCES AND APPLICATIONS

Several cutting edges in one tool holder can be tuned to each other by precisely positioning the tool inserts. The fine adjustment is done during rotation. The ring light also enables a contract-free heat application, which minimizes interferences as would be caused, for example, by slip rings. The mass and volume of the rotating components remains very low, as the ring lights are mounted rigidly to the machine, which is advantageous with respect to the dynamic behavior of the tool holder.

The power circuit and the control of the IR-LED are separated from each other, so that even strong IR-LED currents can be controlled by a commercially available microcontroller. The control permits using several tools simultaneously. The LED ring lights can also be integrated into existing machine tools, the same applies to the tool holder developed for this purpose.

The invention can be used for ultra-pecision milling and micro-turning. In addition, the ring light is capable of focusing a rotating object for illumination or heating.

Photography: Dr.-Ing. Lars Schönemann, IWT.

Tool holder with LED ring lights situated in the front and in the back plus a selectively activated LED

FIELD OF APPLICATION

Ultra-precision machining, micro-machining, heat expansion

KEYWORDS

Fine adjustment, contact-free heating, diamond milling

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