The Japan Society for Precision Engineering

Introduction of JSPE Young Researcher Awards 2018

***1. Katsunari FUKUI* (*Osaka University*)**

Optimization of polishing conditions for reducing thickness variation of wafer in double-sided polishing

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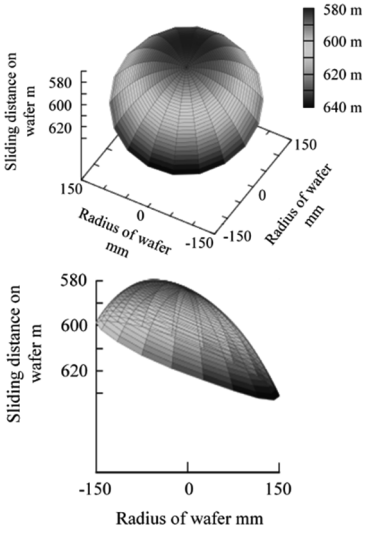
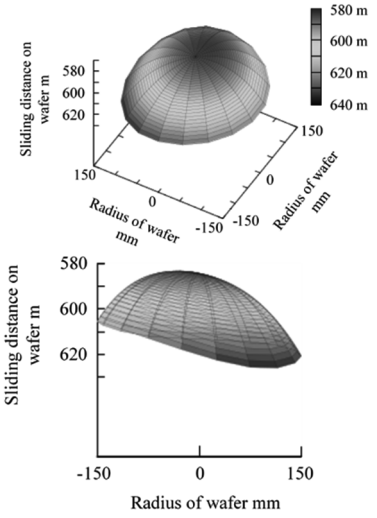
Silicon wafers as the most commonly used substrates for semiconductor devices are strongly required to be manufactured with superior flat surface, that is, small thickness variation to obtain high productivity and performance of the devices. The double-sided polishing (DSP) process is widely adopted as the finishing stage of the wafer manufacturing, because wafers with good surface quality and flatness can be obtained economically. To achieve further good surface flatness of wafers in DSP process with good reproducibility, we investigated a kinematics-based DSP simulation model considering the friction between wafer and pads, the friction between wafer and carrier hole and the pressure distribution on the wafer. On the basis of the simulation model, polishing conditions, in concrete, a set of rotation conditions of upper/lower platens and inner/outer gears were optimized to reduce thickness variation of wafers. DSP experiments on silicon wafers with a diameter of 300 mm revealed that the optimized condition achieved small thickness variation of wafers stably without singular shape.



(a) Tapered shape



(b) Saddle shape

Fig. 1. Distribution of calculated sliding distance on wafer.

***2. Kimiya MURASE* (*Gifu University*)**

High-speed near-IR material discrimination method by using multidimensional response variables PLS regression analysis

J. JSPE, Vol. 84, No. 12, pp. 1050-1058

In this paper, we propose a method to discriminate multiple materials with high-speed based on the spectral reflectance properties of each material in near-infrared ray (NIR) band. A method to discriminate multiple materials with high accuracy using the same properties had already proposed. The previous method discriminates materials by using multiple binary classifiers generated by using PLS1 which is one of the Partial Least Squares (PLS) regression analysis algorithm. However, the method has a problem that it has complicated processes and takes long processing time. In order to solve this problem, we used PLS2 which is one of the PLS regression analysis algorithm just like as PLS1. In this proposed method, multiple materials can discriminate with simpler processes than the previous method by generate a multiclass classifier to discriminate multiple materials. As a result of an experiment, multiple materials were discriminated with almost the same accuracy as the previous method, and the processing speed was improved approximately five times faster than the previous method.

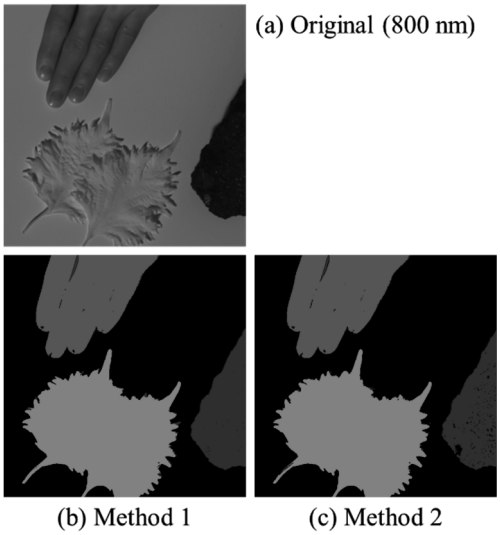


Fig. 2. (a) Original data and (b, c) discrimination results by using 4 wavelengths.

***3. Yonghua ZHAO* (*The University of Tokyo*)**

A novel technique for slicing SiC ingots by EDM utilizing a running ultra-thin foil tool electrode

Precision Engineering, Vol. 52, pp. 84-93

Recently, a multi-wire electrical discharge slicing (EDS) process has been proposed for slicing SiC ingots into wafers. A significant reduction in kerf loss is expected with this method compared with the conventional multi-wire saw method. However, this process entails a high risk of wire breakage. Therefore, in the present study, a novel electrical discharge slicing process utilizing a running ultra-thin foil tool electrode is demonstrated for the slicing of SiC ingots. Relative to multi-wire EDS, the risk of tool breakage can be reduced with this new technique by increasing the tool cross-sectional area. A 25-mm (1-inch) SiC ingot was successfully sliced with the proposed method and a kerf loss of about 100 μm was achieved by utilizing a foil tool electrode with a thickness of 50 μm. This paper summarizes the specific characteristics and results of this process, including the machining stability, machining strategy, selection of foil tool material and multiple simultaneous slicing.

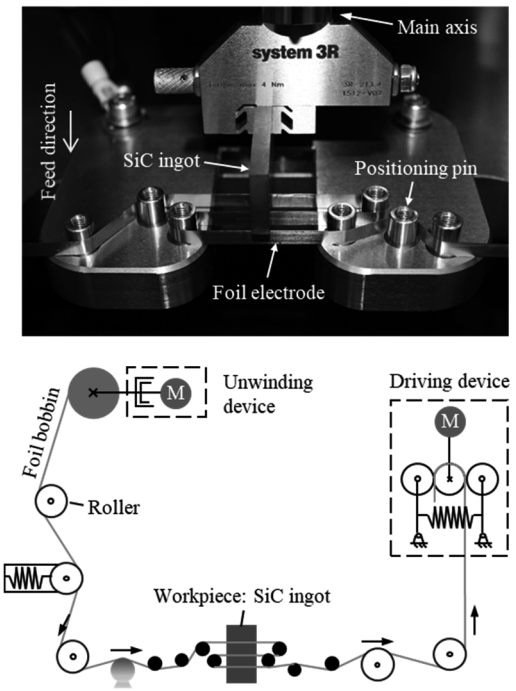


Fig. 3. Experimental setup for multiple foil EDS machining of a SiC ingot.

***4. Agus SUSANTO* (*Hiroshima University*)**

Application of Hilbert–Huang transform for vibration signal analysis in end-milling

Precision Engineering, Vol. 53, pp. 263-277

Signals obtained in metal cutting are often non-linear and non-stationary, so that an appropriate signal-processing technique is needed for the process monitoring. In this paper, machining stability is evaluated by Hilbert–Huang transform (HHT), which can extract the features of vibrating signals. End-milling tests are conducted with thin-walled workpieces to demonstrates the feasibility of HHT in the monitoring for ever-changing state of machining processes. The experimental results obtained are as follows: HHT separated the signal containing chatter from others and can acquire the transition of frequency spectrum during the milling operation. Then, the effect cutting fluid and the influence by biting of hard material are investigated by HHT.

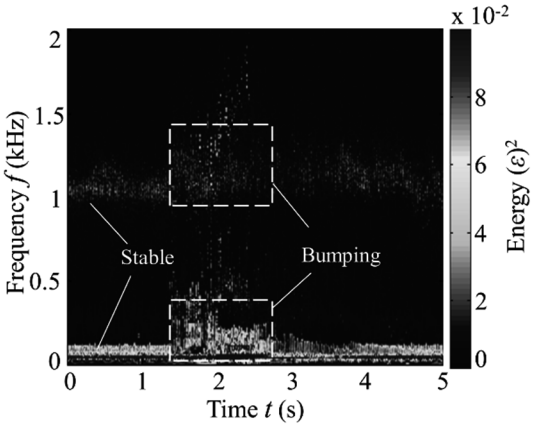


Fig. 4. Hilbert spectrum for transition of strain signal from stable to bumping milling.