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Modelling and experimental study of roughness in silicon wafer self-rotating grinding

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Highlights:

- Surface roughness model in silicon wafer self-rotating grinding is established.
- The model reveals the effects of processing parameters, abrasive grain size, material properties and grinding mark geometry on roughness.
- Roughness model is adopted to predict grinding process in-situ and improve grinding quality.
- The model is potentially employed to monitor the industrial wafer grinding process and optimize the grinding parameters for the minimization of surface roughness.

Abstract

Self-rotating grinding is the most widely used technology to thin silicon wafer. The roughness is an important indicator of thinning quality and processing accuracy. To get a better grinding quality, rigid control of roughness is required. Although the models of roughness in metal and ceramic machining were extensively studied, mechanism of roughness formation in silicon wafer self-rotating grinding was not well understood. In this article, starting from the mechanism of grinding grooves formation, Rayleigh probability density function was used to characterize the depth of grinding grooves. By establishing a relationship between the roughness and the depth of grooves, a theoretical model of roughness was developed. The overlapping effect of abrasive grains and wheel-workpiece deflection were also considered to improve the accuracy of the model. The model could identify the effects of processing parameters, abrasive grain size,

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