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Towards achieving nanofinish on silicon (Si) wafer by μ-wire electro-discharge machining (Article)

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Abstract

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This study investigates the use of nanopowder-mixed dielectric oil and temporary metallic coating on highly doped Si sample to achieve nanometric surface roughness using μ-WEDM operation. To achieve this, two different nanopowders were used in dielectric medium with two different temporary metallic coating in the workpiece. This is with Al and C with metallic coating of (gold) thickness 160 nm and 320 nm. Further, the discharge energy level was varied into two proximate stages (80 V/13 pF and 85 V/0.1 nF). The results show that nanopowder-assisted μ-WEDM process has improved the material removal rate (MRR) by ~ 44.5% (maximum). However, the spark gap (SG) has also been increased to a maximum of 60% than without nanopowder-assisted the μ-WEDM process. Further, it was found in our study that graphite (C) nanopowder usually generates lower spark gap as compared to aluminum (Al) nanopowder. It has also been observed that at specific μ-WEDM condition, coating thickness, and powder concentration C, Al can easily produce nanometric average surface roughness (ASR) (for C lowest ASR was 76 nm and for Al lowest ASR was 83 nm). From the findings, it can be understood that ASR can be improved maximum ~ 65% for C nanopowder and ~ 51% for Al nanopowder-assisted μ-wire electro-discharge machining as compared to conventional μ-WEDM of Si wafer. Machining stability and evenness of the machined slots were also improved by a significant margin when nanopowder-assisted μ-wire electro-discharge machining method was applied. © 2018, Springer-Verlag London Ltd., part of Springer Nature.

Reaxys Database Information

View Compounds

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Average surface roughness | Graphite | Micro-WEDM | Nanopowder | Silicon

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Engineering controlled terms: Gold coatings | Graphite | Nanostructured materials | Silicon | Silicon wafers | Surface roughness | Thickness measurement | Wire

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