

An electrical supply scheme with time interleaving Multi-wire EDM

Wire Electric Discharge Machining (WEDM) is an effective alternative (due to lesser material loss – 15% against 40% and better surface finish) for slicing semiconductor ingots to make wafers used in solar and microelectronics industries. Presently, slicing of semiconductor ingots is done with multi-wire saw which produces several thousand wafers per day. WEDM with single wire cannot match this throughput. However, multi-wire EDM (MWEDM) is not yet commercially available as there are several engineering challenges involved, one of which is as follows.

With conventional electrical supply schemes in MWEDM, very high tension ($\approx 85\text{-}90\%$ of the wires' failure strength) needs to be applied to the wires, which can cause wire-breakage and hinder the process. If this tension is not used, the wires would vibrate due to strong electromagnetic forces, which would affect the surface quality of the cut wafers. Hence, there is a trade-off between cutting speed and the flatness of the cut wafers achievable with MWEDM. This is a critical engineering constraint to design and realize MWEDM.

Our invention provides a pulse generator for an electrical supply scheme for a Multi-Wire Electric Discharge Machining (MWEDM), wherein the electrical supply scheme minimizes deflections and vibrations in the MWEDM connected to the electrical supply.

Features of the invention:

- The invention proposes electric supply schemes with time interleaving such that, the maximum magnitude of forces is reduced to around 20%-50% of that occurring in the existing scheme for MWEDM.
- Consequently, the required tension is also reduced to 20%-50% of that required with the present schemes, and the additional mechanical arrangements will not be required.
- The capability of cutting by MWEDM does not depend on hardness of a material. Hence, the schemes can find widespread applications where conventional multi wire-

sawing is used, apart from slicing semiconductor wafers, e.g. it can be used for making sputtering targets, cutting rare earth magnetic materials, etc.

- The flatness of wafer surfaces cut with the machine is superior to those produced with the machines without the schemes, making MWEDM capable of producing ultra-thin wafers.
- The proposed scheme can reduce net kerf loss.
- The scheme enables MWEDM machine to produce thinner wafers with better surface flatness.
- This scheme can be applied even if the tool is not cylindrical like that in the conventional wire cutting. The shape can be anything like rectangular, foil shaped, etc.