

# Topological Surface of H.S.S and Titanium31 using Micro Electro Discharge Machining

Jush Kumar Siddani, C. Srinivas, N.Nagabhushana Ramesh

**ABSTRACT**---Micro Electro Discharge Machining Drill is variant EDM processes in a situation where it employs water as a dielectric fluid, with pressure flushing and rotating nanotube electrode. This paper brings out the relative features of work pieces i.e., H.S.S and Titanium 31 about their surface roughness and Topological surfaces.

**Keywords:** Micro Electro Discharge Machining Drill (Micro EDM), Titanium 31, High Speed Steel (H.S.S), MRR

## I. INTRODUCTION

The variant EDM process consists of a low energy pulse, water dielectric and a spark gap, flushing with pressure through a nano pipe electrode which is assisted by Taylor coquette flow of the dielectric from the rotation of the electrode. The Electro discharge Machining (EDM) is extensively applied for machining exotic materials and complex shapes. Drilling of micro holes of 0.3 to 3.0 mm, escape holes in dies and pneumatic valves start holes for wire cut EDM etc). The setup illustrated in the Fig: 1.

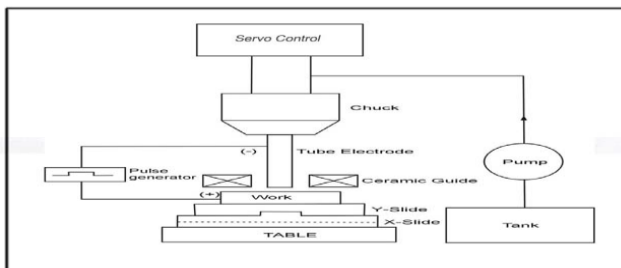


Fig:1 Schematic Representation of Micro EDM Drill

Slender electrode is mounted by a ceramic guide assembly. Thenano- tube Tool and workpiece form a pair of electrodes with electrode negative with uniform gap of few scores of microns. The erosion occurs by high frequency sparks triggered by a square pulse generator. Water dielectric is employed in place of traditional kerosene pulse generator.

The conventional EDM is different for machining small holes owing to poor erosion rates, taper and oversize are typical problems [1]. Frequent short circuits from spark gap contamination by erosion debris [2]. Water as dielectric medium is used efficiently which results in smallest spark gaps, fastest solidification of eroded particles before they

coalesce to form larger size debris [3]. The viscosity is superior due to flushing action.

The main advantage of micro EDM is to machine complex shapes of low force. The force applied is small due to tool and workpiece which have no contact during the machining process. The chattel provides advantage to both the tool and workpiece. Advantages of micro EDM include high aspect ratio, setup cost and better precision with large design freedom. Micro EDM is a contactless MRR process eliminating mechanical stress rattle on and shaking problems during machining. Micro EDM is efficient to machine every type of micro holes with high characteristic ratio.

## II. EXPERIMENT PLAN

The Work pieces are prepared on the Electron Discharge Machine Rapid drill Input factors

Work piece materials of High Speed Steel (H.S.S) and Titanium 31 electrode brass tube of 1mm and 3mm diameter tubes with 0.3 mm diameter holes, pulse current 3 Amps and 6 Amps, pulse on times 6 and 10, pulse off times 4 and 7 (dial positions with increasing order) pulse voltage (100 V) and flush pressure (100 bar) were kept uniform[4]. Output factors and their estimation mode:-

Roundness error of 3D-cmm, are observed at the top and bottom of the hole and the taper.

Surface finish roundness indices on Talysurf. Topological surface and SEM. Scanning Electron Microscope.

## III. RESULTS AND DISCUSSION

Surface Characteristics the results of surface roughness are listed in Table:-I

| Process   | Materials     |                |               |                |
|-----------|---------------|----------------|---------------|----------------|
|           | H.S.S         |                | Titanium 31   |                |
|           | Current (Low) | Current (High) | Current (Low) | Current (High) |
| Micro EDM | 1.13-2.12     | 1.77-2.12      | 0.91-1.02     | 1.94-2.63      |

TableI. Surface Roughness ( $R_a$ ) range in Micro EDM Drill ( $\mu\text{m}$ )

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The finding are as expected but illustrate the surface roughness in titanium 31 compared to H.S.S, sizeable variation in the range of Ra are observed along Titanium 31 surface. The attributed to non uniform attrition occurring to spark discharge is due to short circuit current surge. The eroded surfaces in Titanium 31 were very smooth with good appearance compared to H.S.S, The surface finish and geometric accuracy of Titanium 31 surfaces have significant advantage and lower to H.S.S surfaces.

The high energy of spark discharge produce melt on the spot of it impingement and atomization of liquid metal by the spark forces and expanding gases. The erosion rates in Titanium 31 are high to facilitate the high energy pulses and spark alone could not be the reason but also the short circuits between electrode and work piece with surge of current. Normal spark discharge key amount of molten metal is retained and only a little part is isolated as atomized droplets.

Unstable forces of short circuit provide a large amount expulsion and lower preservation of melt metal. The feature need further explosion of wearing down mechanism of Titanium 31 and H.S.S. using micro EDM drill.

## IV. TOPOLOGICAL STUDY

The eroded surface of work materials H.S.S besides Titanium 31 from Micro EDM are shown in the SEM photographs of Figure 2.

Erosive outcome of spark is substantial similarity of Sparking is a incessant spark discharges; consequently the articulate sparks were employed. The tool electrode is bust anode within Micro EDM drill. The emblematic occurrence of passivating film pattern on anode and evaluation of hydrogen on cathode in favour of gaseous bridgespark gap also ionization of spark channel formation involve the nature of polarity.

The erosion in each case appears elevated quench effect of circulate liquid prevent vaporization. The sizeable retained metal which appear contain resolidified spark zone. Reduction is extensive in Micro EDM Drill owing is soaring quench result in water based electrolyte.

The eroded surface of Titanium31and H.S.S show distinctive form associated along EDM [4] like rupture blisters from dissolve gas, pock marks plus crater after expulsion of melt metal since spark energy. This removal to be superior on Micro EDM Drill owing to superior since watercourse based electrolytealso promote oxidation tendency Titanium 31 in (Fig: d, e,f). Erosive result of spark is also seen from the debris collected. The molten state is clearly seen from the evenly shaped spheroidal particle in H.S.S (Fig.: 3 a).

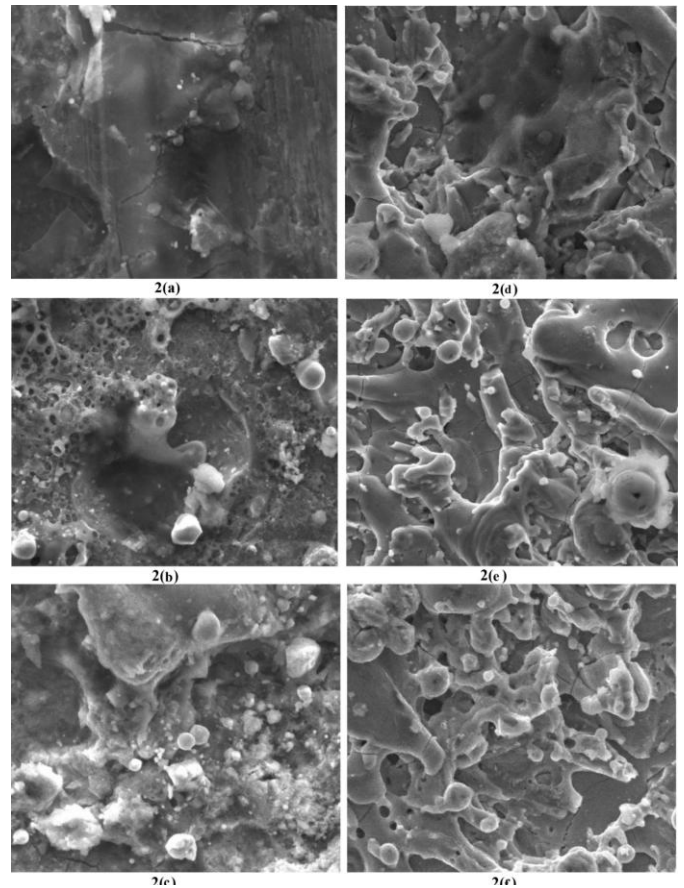


Fig: 2  
SEM photographs 2 (a, b, c) of H.S.S and 2(d, e, f) Titanium 31

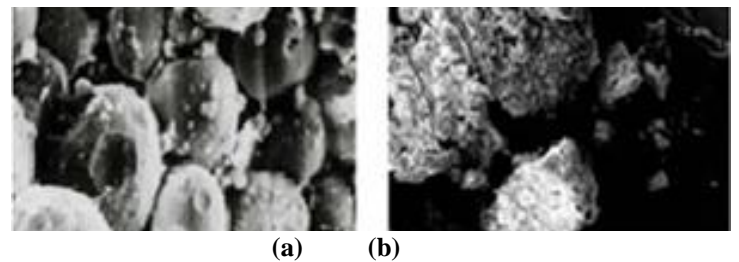


Fig: 3  
(a) SEM Photographs of debris of H.S.S  
(b) SEM Photographs of debris of Titanium 31

However in Titanium 31 the low quench rate water base electrolyte is seen mire pattern with too little time of spheroidization (Fig: 3 b).

## V. CONCLUSIONS

- Micro EDM Drill has considerably lower erosion rates for drilling micro holes.
- The H.S.S and Titanium 31 leads to erosion rates of high thermal also electrical conductive.
- Surface irregularity follows the likely also normal pattern alike near that of erosion rates.

- Considerable reserved metal which resolidified also exhibit typical kind of spark attrition in the form of gas pockets.
- The quenching effect of water as working fluid of Micro EDM Drill on Titanium 31 result into unequal debris stick jointly and appears like sludge form.

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