Generation of Lubricant Layer by Electrical Discharge Machining with Powder Suspended in Working Fluid

Background and problems

- Demands for lubricant on joints of space machines
- Restriction of size and shape in spattering
- Deformations of parts caused by heat

Solution

- Electrical discharge machining (EDM) with solid lubricant powder (MoS₂) suspended in working fluid

Advantages

- Deposition of lubricant during finishing
- Dispersion of lubricant into workpiece

Results

- Surface roughness below 2μmRy by using mixture of MoS₂ and aluminum powder
- Finished surface with lower friction coefficient than that by normal EDM
- Smaller amount of cracks

Applicable fields

- Space robots and machines
- Press molds

Electrical conditions for deposition of MoS₂ during finishing EDM

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polarity</td>
<td>(-)</td>
</tr>
<tr>
<td>Gap open voltage</td>
<td>320 V</td>
</tr>
<tr>
<td>Discharge current</td>
<td>2 A</td>
</tr>
<tr>
<td>Pulse duration</td>
<td>2 μs</td>
</tr>
<tr>
<td>Interval</td>
<td>8 μs</td>
</tr>
</tbody>
</table>

Results of friction test

<table>
<thead>
<tr>
<th>Friction coefficient</th>
<th>Number of reciprocating motion</th>
</tr>
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<tbody>
<tr>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>0.4</td>
<td>2000</td>
</tr>
<tr>
<td>0.6</td>
<td>4000</td>
</tr>
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Without powder

- MoS₂ powder: 2g/l

With powder

- MoS₂ powder: 20g/l

MoS₂ powder: 10wt% (MoS₂: 18g/l, Al: 2g/l)

Ry=3.2μm

Ry=2.0μm

Ry=1.4μm

Applicable fields

- Space robots and machines
- Press molds

Influence of powder concentration

MoS₂ powder concentration: 0, 20, 40, 60 g/l
Ratio of Al: 0, 10, 20, 30 wt%

Influence of electrical conditions

- Pulse duration: 2, 5, 10, 15 μs
- Interval: 20, 40, 80 μs

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Electrical conditions for deposition of MoS₂ during finishing EDM

Polarity (-)
Gap open voltage 320 V
Discharge current 2 A
Pulse duration 2 μs
Interval 8 μs

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