ELECTRO CHEMICAL GRINDING

CH.N.V.JASWANTH

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PGTE

DEFINITION of ECG

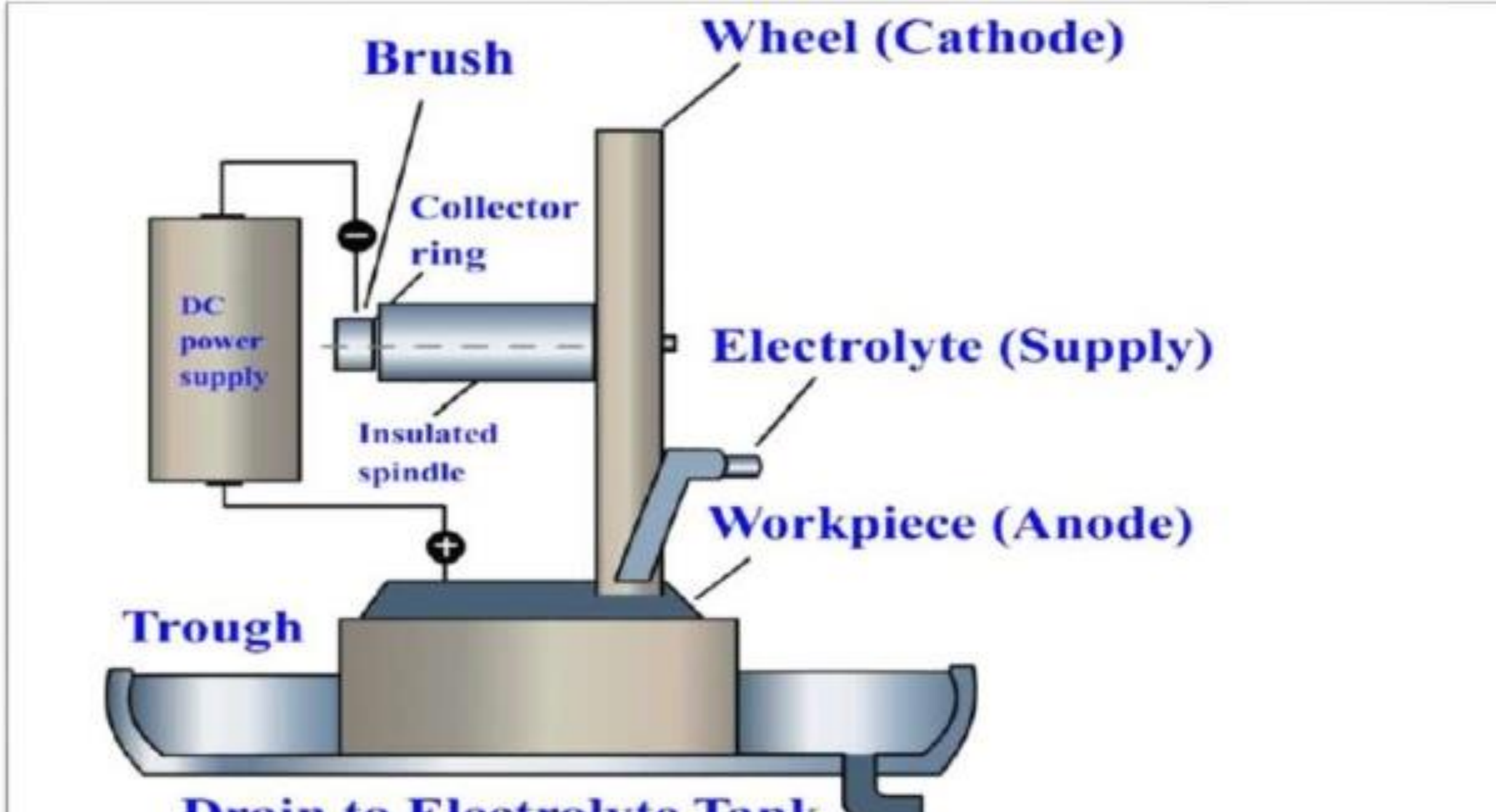
- Electrochemical grinding is a special from of electrochemical machining, which employs the **combined actions of electrochemical attack and abrasion** to rapidly remove material from electrically conductive work pieces, usually hard, tough materials.
- It is a **non-abrasive process** and, therefore, produce precise cuts that are free of heat, stress, burrs and mechanical distortions.
- It is a variation on electrochemical machining that uses a **conductive, rotating abrasive wheel.**
- ECG can be compared to electroplating, but with major differences, ECG deplates material from the work and deposits it in the electrolyte; however, it does not plate material from the work onto the wheel.

Electrochemical grinding overview

- **Electrochemical grinding is a variation of ECM that combines electrolytic activity with the physical removal of material by means of electrically charged wheels**
- **ECG can produce burr free and stress free parts without heat or metallurgical caused by mechanical grinding , eliminating the need for secondary machining operations**
- **Like ECM, (ECG) generates little or no heat that can distort delicate components**

ELECTRO CHEMICAL GRINDING

- The grinding wheel is mounted on the spindle which rotates inside suitable bearings.
- The workpiece is held on the machine table in suitable fixtures. The table moves to and fro to feed the workpiece
- Sodium nitrate, sodium chloride and potassium nitrate with a concentration of 0.150 to 0.300 Kg/litre of water are usually used as an electrolyte.
- The electrolyte from the reservoir is pumped and passed through the nozzle in the gap between the wheel and work piece.
- A constant gap of 0.025mm is maintained between the grinding wheel and work piece.
- The grinding wheel is made of fine diamond particles. These particles are slightly projecting out from the surface and come in contact with the workpiece with little pressure, which runs at a speed of 900 to 1800m/min


Brush
Wheel (Cathode)
Collector ring
DC power supply
Electrolyte (Supply)
Insulated spindle
Workpiece (Anode)
Trough
Drain to Electrolyte Tank

POWER SUPPLY

- The applied current 50-40,000 A
- The voltage must be 5-30V D.C.
- The current density of this process is generally high (20-300 A/cm^2).

Material removal rate

$$\text{MRR} = \frac{W}{A\rho t}\ \text{m/s}$$

Sub W equation

$$\text{MRR} = \frac{EI}{FA\rho}\ \text{m/s}$$

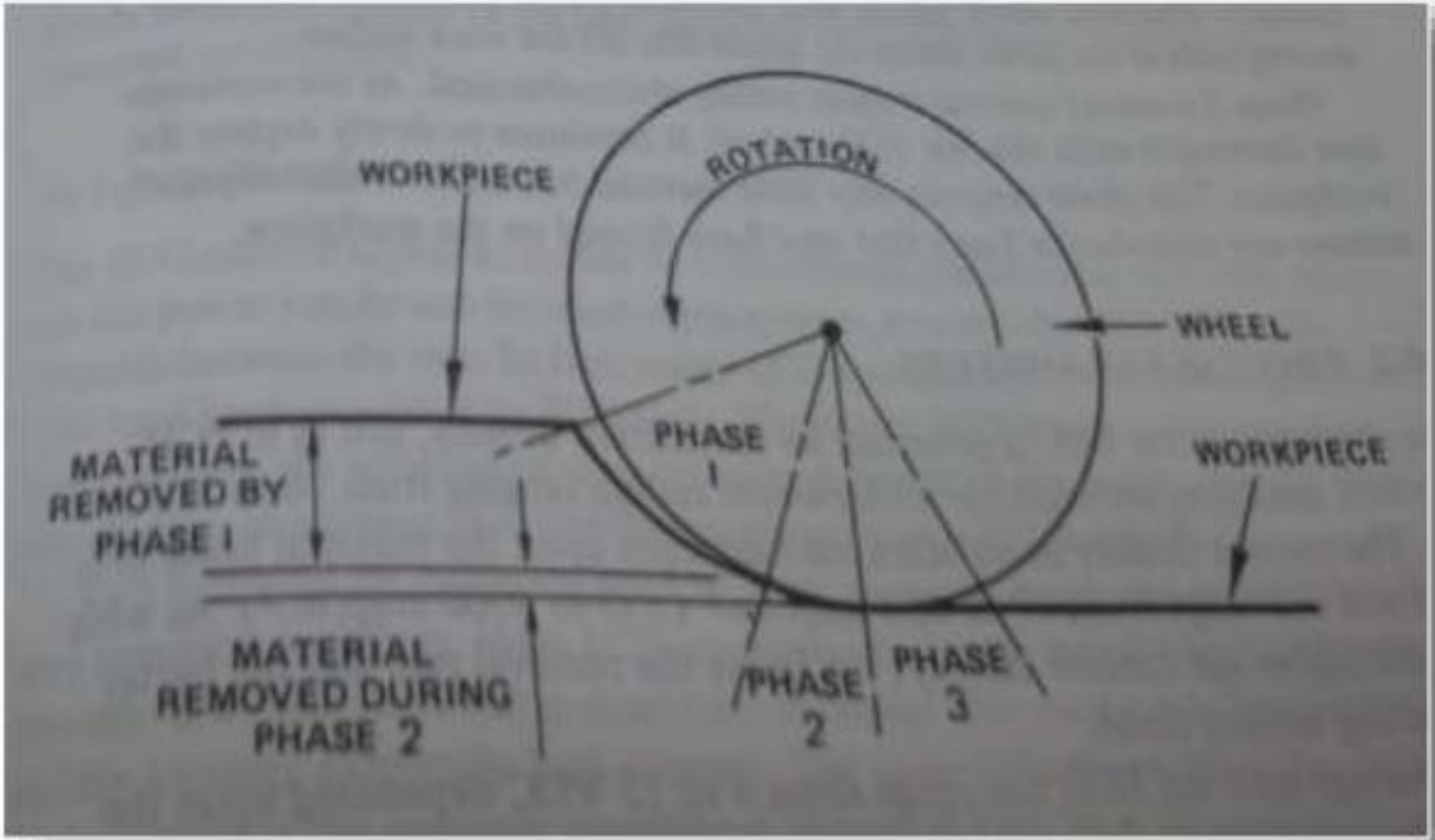
Feed rate of electrode

$$\text{f} = \frac{V}{\rho_s h}\frac{E}{F\rho}$$

A=machined area

V=machine voltage

h=tool work gap


WORKPIECE
ROTATION
WHEEL
PHASE 1
WORKPIECE
MATERIAL REMOVED BY PHASE 1
MATERIAL REMOVED DURING PHASE 2
PHASE 2
PHASE 3

Advantages

- ECG increases wheel life due to negligible wear
- Fixtures used for holding the components are simple in construction
- Cutting tools with specially shaped tips can be ground quickly
- No overheating occurs and hence no surface cracks are produced on parts machined by ECG
- A surface finish up to 0.25 micron is possible
- No metallurgical damage from heat
- Cost of grinding is reduced by 25 – 40%
- More precise tolerances can be obtained

Disadvantages

- High capital cost
- Corrosive environment
- High preventive maintenance costs
- Not economical for soft materials
- Machining of cast iron by ECG present certain difficulties
- Non conducting hard work materials such as ceramics cannot be machined by ECG process

APPLICATIONS

- Primarily used in the grinding of Tungsten carbide tool bits
- Grinding of cutting tools, chilled iron castings , magnet alloys, contour milling of honey- comb structures
- Used for machining of cemented carbides , stellites, refractory materials, stainless steel and high alloys steels without any burr
- Chromium plated materials, flame hardened materials and temperature sensitive alloys can be machined without forming thermal cracks and distortion
- Grinding of super alloy turbine blades
- Burr free sharpening of hypodermic needles

- The ECG process can be applied to the following common methods of grinding.
    1. Face Wheel Grinding.
    2. Cone Wheel grinding.
    3. Peripheral or Surface grinding.
    4. Form Wheel or Square grinding.

Thank you