Hard Particle Mixed Silver-Copper Based Brazing Filler Material for Joining Diamond to Steel Substrate

IITM Technology Available for Licensing

PROBLEM STATEMENT

- **Diamond is used in super-abrasives** for **cutting/grinding tools** like **grinding wheels**, dressing and truing tools, and honing discs.
- **Electroplating** or brazing technology is used to **join diamond grits** with a **metal substrate**.
- Brazing technology offers superior joint strength by developing a chemical bridge at the grit-alloy interface.
- Diamonds **metastable at higher temperatures** can deteriorate cutting edge sharpness and cause micro-cracks.
- Low melting temperatures and soft or ductile-based filler alloys are suggested to address these issues.
- Active **Ag-based** filler alloys have **lower hardness value,** leading to inferior abrasion resistance.
- **Need for improved filler alloy formulations** and silver-copper-based filler material for diamond to steel substrates.

TECHNOLOGY CATEGORY/ MARKET

Technology: Filler Material For Joining Diamond to Steel Substrate
Category: Assistive, Test Equipment & Design Manufacturing
Industry: Abrasive Manufacturers, cutting tool Manufacturers
Application: Machining operation
Market: The global market size estimated at **USD 47.34 billion in 2024**, and is expected to reach **USD 66.83 billion by 2029,** growing at a **CAGR of greater than 5%** during the forecast period **(2024-2029).**

INTELLECTUAL PROPERTY

IITM IDF Ref. 1707
Patent No: IN 461065

TRL (Technology Readiness Level)

TRL- 4, Experimentally validated in Lab;

Research Lab

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TECHNOLOGY

Formulation of active brazing filler alloy (ABF1)

Flow Chart 1

1. **Active brazing filler alloy (ABF1) is composed of Ag, Cu, TiH_2 and nano-diamond particles. 3-5 wt% of TiH_2 and 0.5-0.7 wt% of nano-diamond particles are added to the eutectic 72Ag-28Cu alloy**
2. **Mix the constituents of the filler alloy thoroughly using binder dissolvable in isopropyl alcohol.**
3. **Resultant alloy prepared is then used for the joining of synthetic diamond grits to a medium carbon steel substrate**
4. **The entire assembly is heated inside a high vacuum environment to a temperature of 850°C for joining synthetic diamond grits to a medium carbon steel substrate**

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Formulation of active brazing filler alloy (ABF2)

Flow Chart 2

1. • Active brazing filler alloy (ABF2)
   • composed of Ag, Cu, TiH_2 and 2-10 wt% of micro TiC particles have been added to passive silver copper alloy containing 2-3 wt% of TiH_2
2. • Mixing
   • Mix the constituents of the filler alloy thoroughly using binder dissolvable in isopropyl alcohol
3. • Prepared alloy was heated to a temperature of 820°C for brazing diamond to a medium carbon steel substrate and resultant alloy prepared is then used for the joining of synthetic diamond grits to a medium carbon steel substrate

Key Features / Value Proposition

- **Filler Material**
  - **Vacuum Level**
    - The filler material wherein the vacuum level maintained during the brazing process was in the range of **10^{-6} to 10^{-7} mbar.**
  - **Heating Temperature**
    - The filler material wherein the entire assembly is heated inside a high vacuum environment to a temperature of **850 °C.**
  - **Wear Resistance**
    - The filler material wherein the nano-diamond added filler demonstrates **wear resistance** property by **50-60%** and the brazed joint strength is **reduced by 30-40%**
  - **Abrasion resisitance**
    - Filler alloy exhibited a significant increase in the **abrasion resistance** property by about **73-91%** and the brazed joint strength was reduced by an extent of **20-30%**

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