BIO-INSPIRED TEXTURED TURNING TOOL FOR SUSTAINABLE MACHINING OF DIFFICULT TO MACHINE MATERIALS

IITM Technology Available for Licensing

PROBLEM STATEMENT

- With the development in technology, several new engineering materials are coming in the market having extraordinary properties. However, it is **very difficult** to machine these materials due to low thermal conductivity and high hardness an thus it results in generation of **higher cutting forces**, **higher tool wear & poor surface finish**.
- Therefore, there is a requirement to address above issues using **sustainable technique** i.e. the application of **bio-inspired surface textured too**l by improving the tribological properties at the tool-workpiece interfaces.

TECHNOLOGY CATEGORY/ MARKET

Technology: Cutting Tools;
Industry: Material Industry;
Applications: Sustainable turning tools, Stainless steel work piece,
Market: The global **turning tools** market size was valued at $5.3 billion in 2021, and is projected to reach **$12.1 billion** by **2031,** growing at a **CAGR** of **8.3%** during the forecast period from **2022 to 2031**.

TECHNOLOGY

- Present Patent describes about **bio-inspired micro-crescent textures mimicked** from the **lunate cell of the nepenthes alata pitcher plant & micro textures were** generated on **the rake and flank surface of the carbide tool for reducing the cutting forces** by **decreasing the friction** between the **interfaces of tool & workpiece.**
- Said **bio-inspired micro-crescent textured tool** is utilized for the **sustainable machining** of difficult to machine materials such as martensitic AISI 420 steel.
- The **micro-textures** help **in reducing the friction** between **the tool workpiece interfaces** by acting as reservoir of air resulting in **better heat transfer between them.**
- It also helps in **greener machining** as it **doesn't utilize any cutting fluids** during the **dry machining operation.**
- The illustration of claimed invention is shown in figures.

KEY FEATURES / VALUE PROPOSITION

❖ ***Technical Perspective:***

1.The micro-crescent textured tool machined surface exhibit **lower residual stress** generation of **390.2 MPa** relative to **608.3 MPa** using **conventional tool**.

2. The bio-inspired micro-crescent textured turning tool exhibit **lower tool-chip contact area** of **4.3 E+05 μm²** relative to **7.8 E+05 μm²** using **conventional tool**.

❖ ***Industrial Perspective:***

1. The micro-crescent textured tool exhibit **a reduction of 56.44% in flank wear** relative to **conventional tool**.
2. The micro-crescent textured tool showed a **reduction of 19.04%** in **tangential force** & **28.91%** in the **feed force** relative to **conventional tool**.

INTELLECTUAL PROPERTY

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TRL (TECHNOLOGY READINESS LEVEL)

TRL- 3, Proof of Concept ready & validated

RESEARCH LAB

Prof. Somashekhar S Hiremath
Dept. of Mechanical Engineering,

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719

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Images

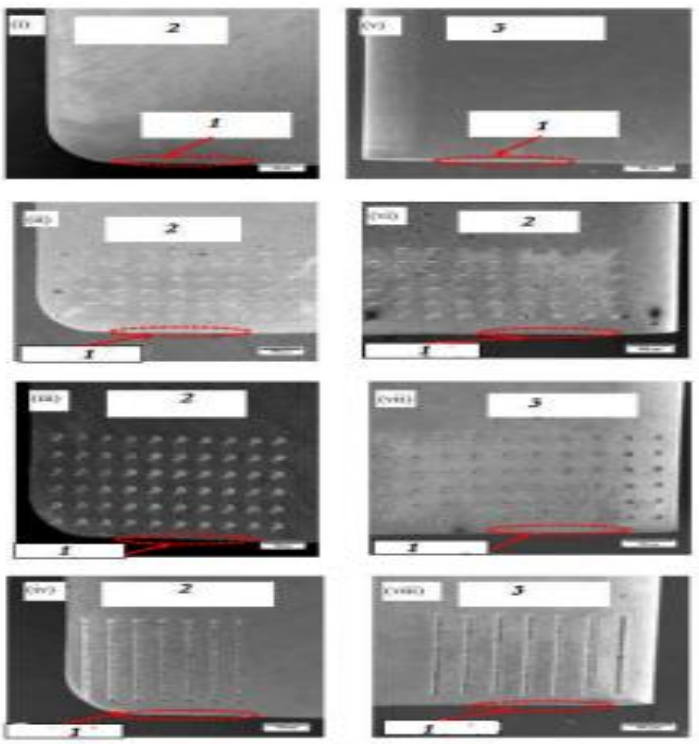

FIG. 1: Illustrates SEM micrographs of rake surface and flank surface of conventional and different geometrical textured tools (i), (v) conventional tool, (ii), (vi) micro-crescent tool, (iii), (vii) micro-dimple tool, (iv), (viii) micro-groove tool;

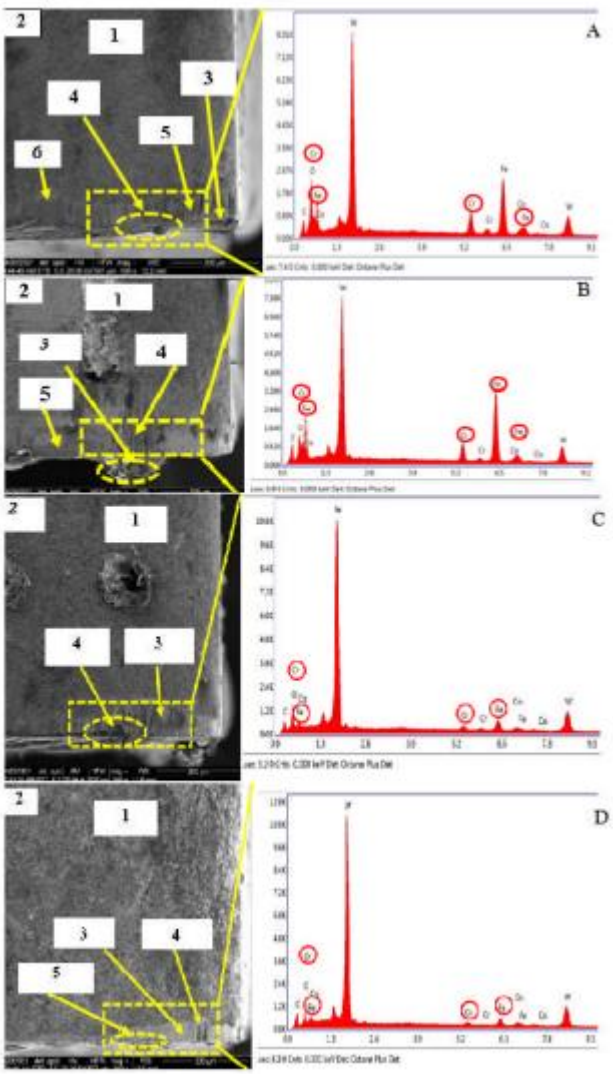

FIG.2 illustrates the SEM image and its corresponding EDS analysis of the conventional tool and bio-inspired micro-crescent textured tool's flank surface. Figure A shows: 1- Flank surface; 2- Conventional tool; 3- Chipping; 4- Built up edge; 5- Abrasion, 6- Plastic deformation. Figure B shows: 1- Flank surface; 2- Micro-groove textured tool; 3- Built up edge, 4-Notch wear; 5- Abrasion. Figure C shows: 1- Flank surface; 2- Micro-dimple textured tool; 3- Abrasion; 4- Chipping. Figure D shows: 1- Flank surface; 2 – Micro-crescent textured tool; 3- Abrasion; 4- Notch wear; 5- Clean cutting edge.

CONTACT US
Dr. Dara Ajay, Head
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719