



Industrial Consultancy & Sponsored Research (IC&SR)

A system and method for measuring cutting-edge radius of edged tool

IITM Technology Available for Licensing

PROBLEM STATEMENT

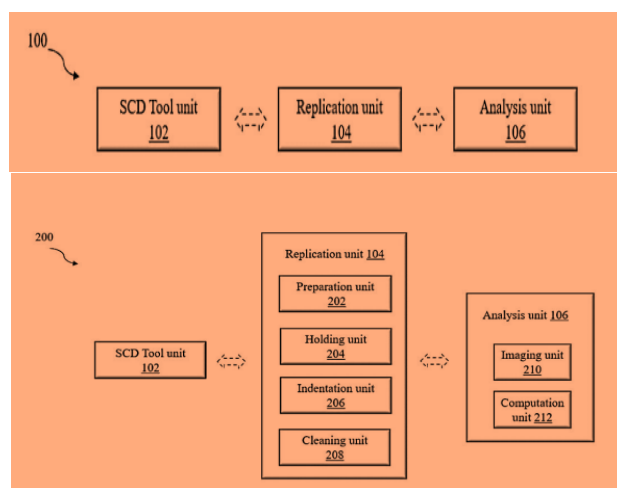
- **Single crystal diamond (SCD) tools** are used in ultra-precision machining for **machining optical surfaces** with nanometric surface finish.
- The machined surface finish quality **depends on the tool's cutting-edge radius**.
- **Optical 3D sensors** are used for measurement but due to light diffraction phenomenon, nanometric resolutions **cannot be measured**.
- Some systems used a **scanning electron microscope chamber**, due to SCD tool being a non-conductive material, thereby resulting in charging effect and to overcome this effect, the cutting edge of the SCD tool was **coated in gold** to measure edge radius.
- However, this **resulted in non-uniform thickness**, thereby resulting in limiting the accuracy of the tool.
- Further, in **AFM technique** the alignment of SCD tool tip with the AFM scanner and it is **time consuming**, **expensive**, and also holds a high risk of AFM tip breakage.
- There is **need for a system and method** for **measuring cutting-edge radius** on single-crystal diamond tool for precise quantitative measurement.

Research Lab

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TECHNOLOGY

System



TECHNOLOGY CATEGORY MARKET

Category: Applied Mechanics & Mechanical Engineering/Photonics/Advance Material & Manufacturing

Industry: Optics Manufacturing, Research labs, universities.

Application: Ultra-precision machining for SCD Tool in machining optical surfaces.

Market: The global market size is valued at **24.30 billion in 2022** and is predicted to reach **59.74 billion by the year 2031** at a **10.73% CAGR** during the forecast period for **2023-2031**.

INTELLECTUAL PROPERTY

IITM IDF Ref. 2299;
Patent No: IN 533356;

TRL (Technology Readiness Level)

TRL-4, Experimentally validated in Lab;

- A **system for measuring cutting-edge radius** on an edged tool comprising:
- **Edged tool** positioned in a tool holder.
- A **replication unit** has a holding unit configured to receive **at least two metallic blocks**.
- An **indentation unit** configured to forge an **indentation** of predefined depth by **thrusting and retracting** the edged tool onto the at least two metallic blocks forming the indentation
- An **imaging unit** configured to **capture one or more images** of the indentation and convert the one or more captured indentation images to one or more binary images.
- A **computation unit** configured to **calculate an edge radius for the edged tool** based on a calculated elastic recovery factor value and an intended radius experimental value.

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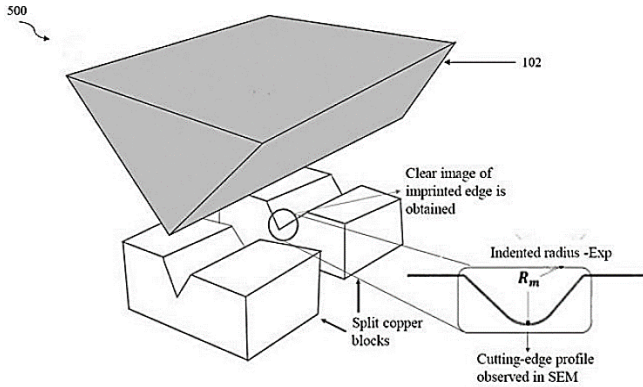


Figure 1 illustrates observing a cutting-edge profile of an indentation.

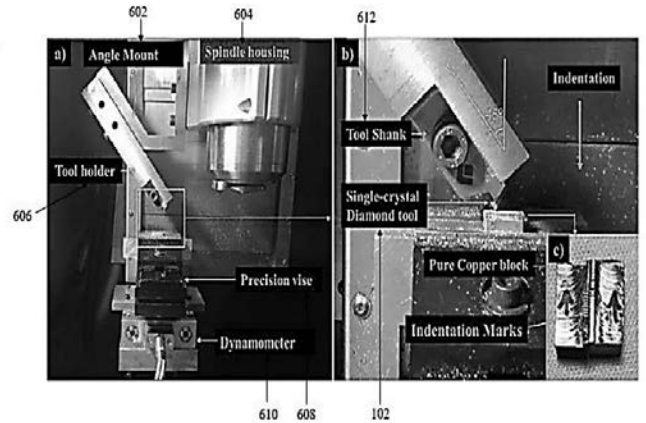
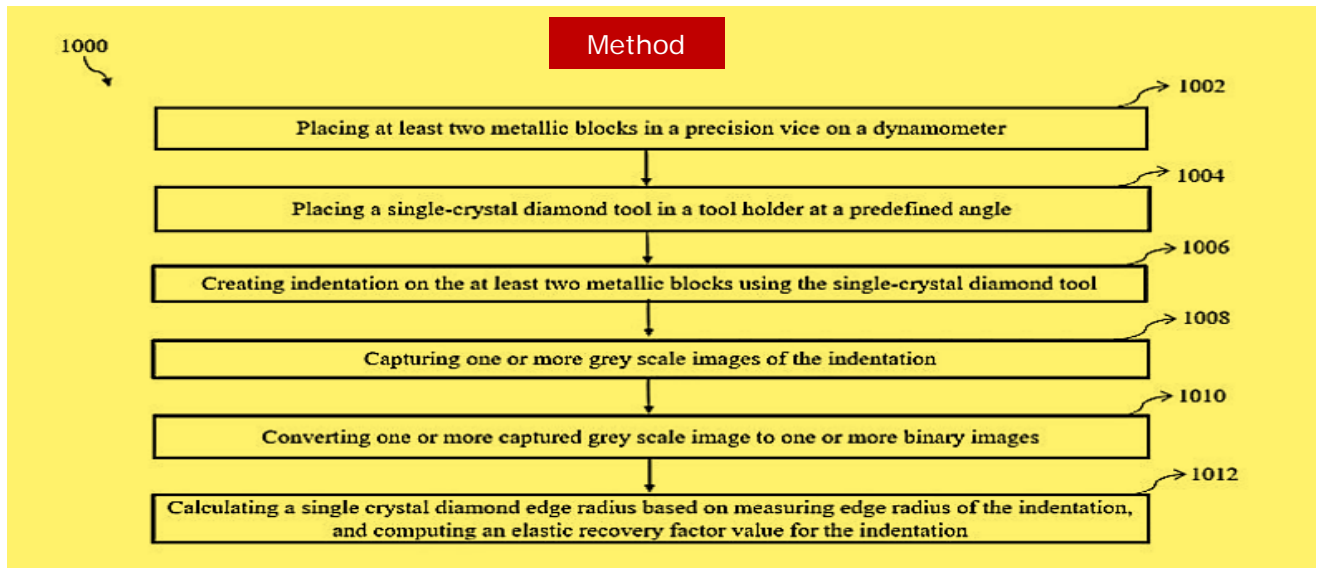


Figure 2 illustrates a system procedure images.



Key Features / Value Proposition

- ❑ An **accurate edge reversal method** for edged tool edge radius characterization.
- ❑ Provide an **indentation of sharp cutting edge** of the edged tool at a **predefined angle** on at least two metallic blocks.
- ❑ Provide a **cross-section of the indentation** on the at least two metallic blocks by **replicating and analyzing** a cutting edge profile of the edged tool.
- ❑ Creating a **replica of the cutting-edge profile** by indenting the smooth surface of the substrate, **without damaging the cutting-edge**.
- ❑ **Cutting-edge radius of the SCD tool typically from 10 nanometers.**
- ❑ **Cost efficiency** in optics surface finish manufacturing.

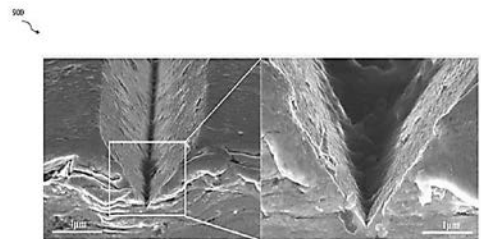


Figure 3 shows a SEM image of the cutting-edge profile.

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