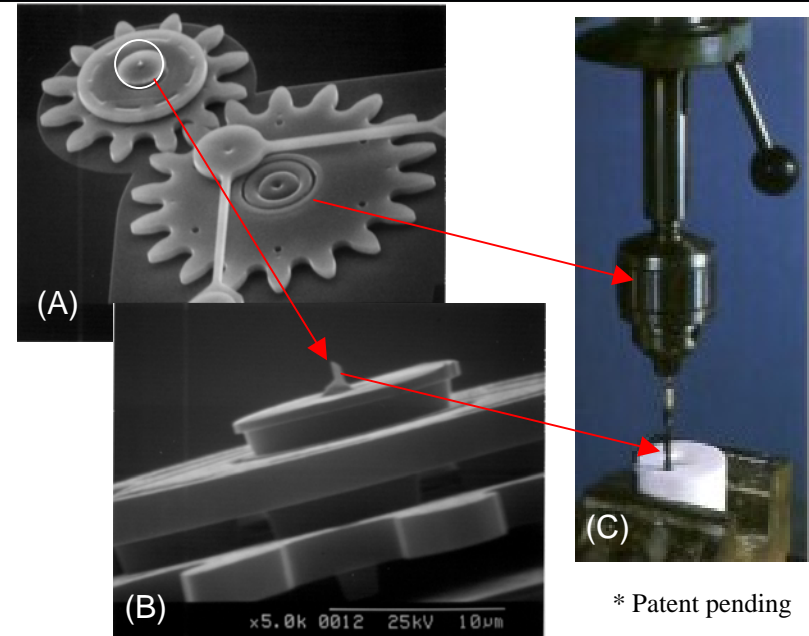


Goals and Potential Impact if Successful

- Design, fabricate and test a nano mechanical machining system on a chip* (tool, tool holder and their actuation; Graphics A, B), a dynamic scanning probe machining tool, with intention of performing operations such as drilling and milling analogous to its macro counterpart (Graphics C).
- Mechanical machining tools for top-down nano manufacturing of difficult-to-machine materials.
- Pushing application of traditional mechanical machining approach in nano paradigm for directed assembly of heterostructures.
- An excellent testbed to learn materials, mechanism, mechanics and tolerance issues at nanoscale.



Approach and/or Accomplishments

- Design a micro electro mechanical system (MEMS) based nano machining platform.
- Fabrication of the silicon based nanomachining system-on-a-chip (SOAC) in a batch-fabrication (Graphic A).
- Develop a process to define nanomechanical machining tool (Graphic B).
- Develop scheme for the SOAC installation and demonstrate machining, analogous to macro-machining (Graphic C).
- Successful demonstration of world's smallest nano mechanical machining mechanism.
- Education of engineers in the area of nanomanufacturing.
- Involvement of Junior High School students to create a medium for education of the society.

Bottlenecks and Open Research Questions

- Fabrication of micro system for nano machining and writing
- Fabrication of nano tools and analysis
- Tolerance analysis
- Feed back control system
- Machining and writing process analysis
- Tribological study

Related References from Malshe's Group- (1) "Mechanical Strength Measurements of Silicon Nano-structures Using Scanning Probe System: An NDE Approach," *Journal Smart Materials and Structures*, vol. 28, pp. 1028 (2003). (2) "Geometric Error Assessment of a Nanomechanical Drill," *Proceedings of IMECE'03, 2003 ASME International Mechanical Engineering Congress & Exposition, Washington, D.C., November 16-21, 2003*. (3) "Design Consideration, Process, and Mechanical Modeling, and Tolerance Analysis of MEMS-based Mechanical Machining Systems-on-a-chip (SOAC) for Nanomanufacturing," *Proceedings of IMECE 2002, ASME International Mechanical Engineering Congress and Exposition, November 17-22, 2002 New Orleans, Louisiana*.