TIP Project Brief – 100071/11H009

Manufacturing
Low cost, scalable manufacturing of surface-engineered super-hard (SESH) substrates for next generation electronic and photonic devices

Develop the means to fabricate high-quality, super-hard substrates in a rapid, reliable, scalable, and cost-effective manner.

Sponsor: Sinmat Inc.
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- Project Performance Period: 2/1/2011 - 1/31/2014
- Total project (est.): $4,801 K
- Requested TIP funds: $2,398 K

Sinmat is pursuing a practical, cost-effective solution to a hard technological problem impeding progress toward next-generation integrated circuits, advanced power electronic devices, and enhanced solid-state-lighting technology. The company plans to develop commercial-scale methods for making super hard, low-defect substrate materials and engineering the surfaces of these advanced technology platforms to eliminate roughness and optimize properties for particular applications. Success could pave the way for silicon-on-diamond (SOD) substrates to meet the need to rapidly dissipate heat on future generation integrated circuits. By 2016, according to the semiconductor industry's technology roadmap, the thermal properties of the current substrate material—silicon on insulator—will fall short of what is needed.

However, SOD technology is not ready to fill the void because methods currently available cannot smooth diamond surfaces to the required level—less than 1 nanometer in variation. Near perfect surfaces on super hard substrates also are required for improving brightness of light emitting diodes, eliminating defects that impede the performance of high-power devices, and creating large sheets of graphene of the desired thickness to enable commercial applications of this promising, but still experimental nanoscale material.

Sinmat's surface-engineered super-hard substrates are designed to greatly reduce surface roughness, reduce defect density, and enhance light reflection. The company proposes to refine and scale up its state-of-the-art chemical mechanical polishing techniques for engineering the surfaces of gallium nitride, silicon carbide, diamond, and other extremely hard materials. This capability could spawn an estimated $1 billion market for super hard materials with engineered surfaces, enhance energy efficiency in lighting and other products, and reduce manufacturing costs in the semiconductor industry.

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