Startup Contest Application

International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication

1. Venture Name. 3D Nanotech

2. Team Leader and Primary Contact Information.

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3. Additional Team Members.

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4. Describe the business opportunity.

The photonics industry faces limitations due to the lack of low refractive index materials for efficient use in optical technologies. This limits the development of photonic waveguides and optical sensing technologies that require precise index tuning. 3D Nanotech proposes a scalable, airgap-based 3D multi-layer porous nanolattice structure that can be integrated into existing photonics hardware, exhibiting a refractive index as low as 1.025, with precise index tuning in the order of $\Delta n=10^{-4}$, and high structural stiffness in the GPa range.

5. Describe your technological solution.

3D Nanotech's solution is a nanolattice material that can be integrated into photonic waveguides and optical sensing hardware technologies. The nanolattice material is fabricated using roll-to-roll colloidal nanosphere lithography, developed and then coated with a thin layer of titanium oxide using atomic layer deposition to obtain porous nanolattice structures that can be used to create precisely tunable refractive index layers on top of each other at scale in the future.

6. Who is your competition and what are your product differentiators?

The proposed nanolattice material has a refractive index of 1.025 that comes close to approximating the index of air (n=1.0), which is 22% lower than existing commercially available polymer-based materials. It also provides mechanical robustness (*stiffness, E > 5 GPa*) that cannot be achieved using existing polymer-based materials. The material can be used to build smaller, faster, more energy-efficient displays that produce sharper and more realistic images, making it valuable for applications in high-risk environments such as healthcare, aerospace, and industrial automation. Moreover, current polymer-based materials can only

reach refractive indices as low as 1.31. Table 1 lists the refractive index of a few commonly known materials for comparison.

7. Describe the Market Opportunity. [Optional Section]

3D Nanotech has garnered interest from a major AR/VR display headset company and is in talks to prototype and incorporate the material into their display hardware. The global VR market was valued at $21.83 Billion in 2021 and is expected to grow to $28.42 Billion by the end of 2022, with a compound annual growth rate of 51.8% between 2020 and 2026.[1] The hardware component industry is expected to share nearly 15.1% of revenue among total VR ecosystem revenue, and 85% of the development cost of AR/VR products comes from the hardware components that 3D Nanotech hopes to target in the future.

8. Describe the Team. [Optional Section]

The team consists of
Dr. Chih-Hao Chang, *(Co-founder, and CTO),* an Associate Professor in the Walker Department of Mechanical Engineering at The University of Texas at Austin. His research focuses on developing 2-dimensional and 3-dimensional multifunctional nanostructures with novel physical properties and novel scalable nanomanufacturing techniques based on both "top-down" and "bottom-up" principles.

Saurav Mohanty, *(Co-founder, and CEO)* is the team leader and currently a doctoral student in Mechanical Engineering at The University of Texas at Austin. Prior to joining UT Austin in 2020, he obtained an MS degree in Mechanical Engineering at North Carolina State University in 2019. His current research focus includes using modeling of colloidal assembly for near-field 3D nanolithography and extreme ultraviolet (EUV) lithography with applications in photonic nanostructures.

Dr. Chang will be the technical advisor of the 3D Nanotech team offering years of expertise in nanofabrication. **Saurav** will lead day to day operations and business growth of the company as it transitions out from the university lab to a successful and scalable company. The team is considered a winning combination because they have been working together for over 5 years now and have undergone a national NSF I-corps program together where they studied the market opportunity of this technology to move forward with the idea of starting a commercial venture. The team has also submitted an NSF PFI grant proposal to conduct further prototype studies.

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[1] MarketLine (2022) – *Global Virtual Reality*. Available at: http://advantage.marketline.com. (0199-2931).
[2] Chen, I.-T.; Dai, Z.; Lee, D. T.; Chen, Y.-A.; Parsons, G. N.; Chang, C.-H. Fabrication of Non-Uniform Nanolattices with Spatially Varying Geometry and Material Composition. *Adv. Mater. Interfaces* **2021**, *8* (17), 2100690.

Figures and Additional Information

Table 1: Refractive indices of commonly available

Material	Refractive Indices
Air	1
Proposed Nanolattice Material	**1.025-1.31**
Water (Ice)	1.31
Polymers	1.3-1.8
Fused Silica	1.46
Crown Glass	1.48-1.75
Sapphire	1.76
Diamond	2.4
Silicon	4

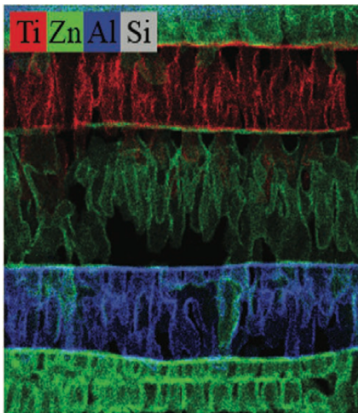

Fig. 1: STEM image of proposed multilayer nanolattice technology.[2]

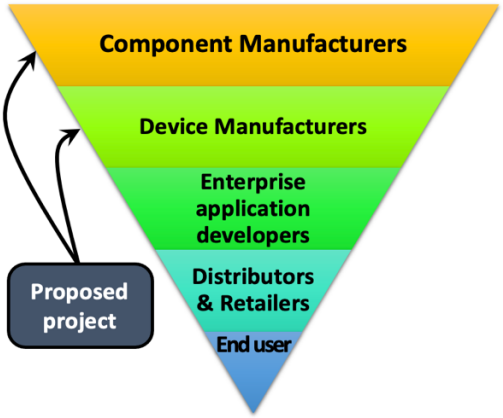

Fig. 2: Value chain pyramid for AR/VR ecosystem

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