



# Novel 3d Photo-thermal Printing of Metals & Composites



## The Problem

While 3D printing of polymeric materials is prevalent, metals are indispensable for structural support, heat dissipation and electrical conductivity. Extensive research to allow additive manufacturing (AM) of metals has resulted in a range of techniques, the most established of them are selective laser melting (SLM), electron beam melting (EBM) and metal inkjet printing. Alas, these methods are not suitable for the microscale regime due to minimum line width of tens of microns, limited by the size of metal particles used and heat dissipation.



## The Solution

Our new technology, based on photo-thermal reduction of metal ions, is breaking new ground in several aspects:

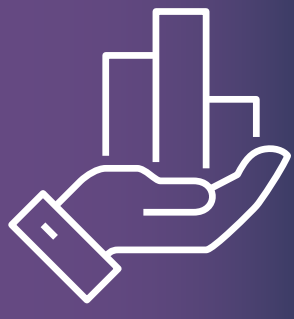
- Very fine (~1µm feature size) single metal OR multiple metals structures.
- Very good and homogenous structure with very fine surface roughness due to the built-in sintering process.
- Ability to combine nano-diamonds, nano-carbon particles and such (composite formation) for better finished material properties (either electric, magnetic, heat transfer etc.)



## The Commercial Benefit

This technology aim at 3D printing of metals, alloys and metal composites with high resolution (~1µm in X,Y and ~300nm in Z). A unique method of 3D printing has been developed, with the following advantages over existing worldwide technologies:

- This technology do not require expensive femto-second lasers, but rather cheap CW lasers (<1W).
- While previous works demonstrated 3D printing only for metal ions with high reduction potential (silver), this technology can 3D print even ions with low reduction potentials (such as Iron).
- This technology can combine various nanoparticles (such as diamonds, carbon, metal oxides, polymers etc.) in the metal matrix for better finished material properties (either electric, magnetic, heat transfer etc.).
- Our process does not require chemical additives for the reduction process.



## Market Potential

The global 3D printing metals market is expected to reach USD 2.86 billion by 2025 at CAGR: 31.0%. Metals have been witnessing significant growth in the 3D printing market due to high strength and lightweight of the finished product. Various end-use industries have been trying to inculcate metal 3D printers as mainstream manufacturing equipment in order to reduce their lead time and increase profitability, which is expected to drive the market.



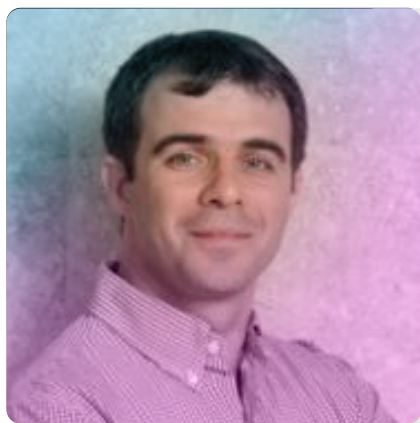
## Target Markets/Industries

- Medical Industry
- Dental Industry
- Aerospace Industry



## Intellectual Property

Patent pending



## Team: Primary Inventor

### Dr. Hagay Shpaisman

- Dr. Hagay Shpaisman is affiliated to the Department of Chemistry, Bar Ilan University.
- He has published numerous publications in various national and international peer-reviewed journals and presented scientific papers across the world.
- Dr. Hagay Shpaisman contributions are appreciated by various reputed awards.
- Dr. Shpaisman clinical and scientific research interests include Influencing polymerization & phase separation processes with Holographic Optical Tweezers, Developing bubble based acousto-driven micro-particles, Advancing light controlled microfluidics, Creating position sensitive micro structures.



## Future Research

- Optimization for various metals and composites
- Improving adhesion between different printed materials



## The Opportunity

We invite Industrial companies to license our patent through a licensing agreement with sponsored research.



## Keywords

- Redox-flow batteries,
- electrocatalyst
- Energy storage systems,
- Hydrogen Bromine technology,
- HBr,
- RFB systems.