



RAY TECHNIQUES LTD.
OLGA LEVINSON, CEO

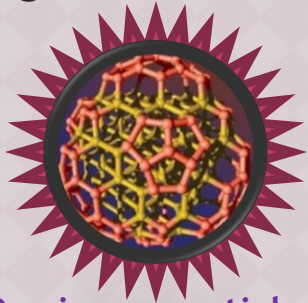
HORIZON 2020
PROPOSAL FOR MANUFACTURERS
OF PLASTICS, ADHESIVES, LAMINATES & PCB
AND FOR ACADEMY RESEARCHERS

**DIAMOND INSULATING
THERMAL CONDUCTIVE
ADHESIVE (DITCA)**

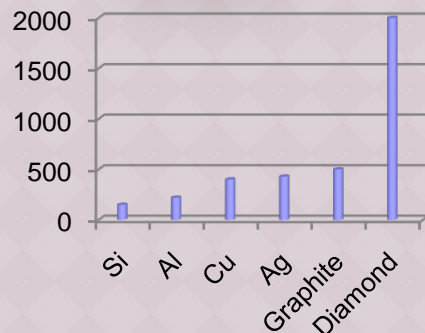
RESEARCH BACKGROUND

Ray Techniques Ltd. is an Israeli SME established in 2009 and engaged in nanodiamond (ND) technologies:

- Proprietary technology for producing ND powder of high quality
- Know-how for ND disaggregation and dispersion within various media
- Design novel highly efficient ND-based products including thermal grease and thermal adhesive for electronics



ND primary particle



Thermal conductivity

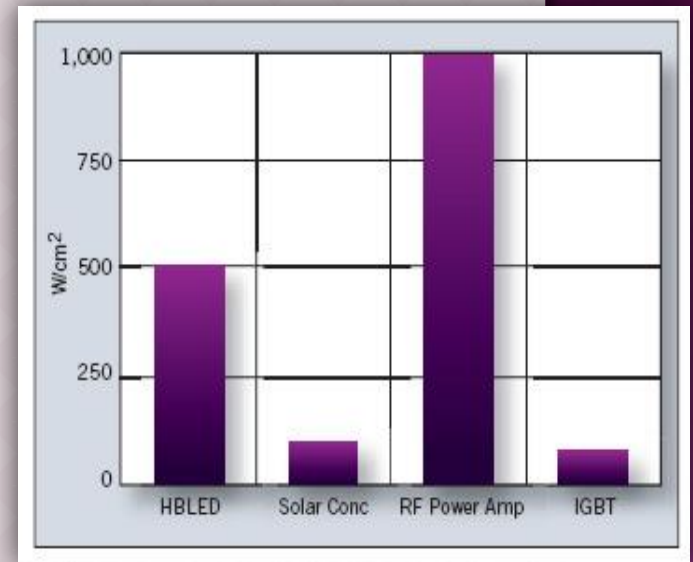
- Diamond core (yellow) with average size of 4-5 nm and unique diamond properties including highest **thermal conductivity** (Fig.2) and **electrical resistance**
- Graphene-like structure (pink)
- Active surface shell of functional groups with unpaired electrons (crimson) - controlled surface chemistry enabling desired interaction with molecules of basic liquid
- ❖ **ND uniformly introduced in some media transfer them unique features of diamond**

OBJECTIVE

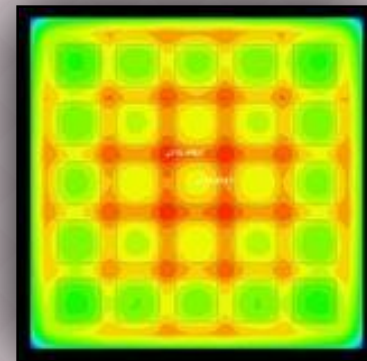
The Problem:

- The miniaturization of power electronic modules has led to the significant increase in power density and heating of active elements, limiting their high-speed performance and frequency
- Overheating results also in untimely degradation of TIM causing device failure
- A major constraint limiting efficient heat dissipation, as well as reliability and durability of electronic devices, is a high thermal resistance of TIMs, especially insulating polymers

The Goal: development and implementation of novel heat conductive insulating materials meeting the rising requirements of modern electronics



Average power density of high-power semiconductor devices



Local hot spots can have energy densities up to three times higher than the average

PROPOSED TECHNOLOGY

Proposed solution

1. Uniform dispersing specially modified ND within polymer matrix
2. Synergic effect of using ND and modified dielectric graphene / BN
3. Special additives enhancing the wettability of the bonded surfaces and increasing their adhesion with TIM

Advantages

- ⦿ High performance
 - Increase in thermal conductivity
 - Improved insulation properties
 - Possibility to reduce the thickness of insulating layer and to reduce thermal impedance
 - Improved adhesion additionally reducing thermal resistance
 - Low moisture absorption & resistance to humidity
- ⦿ High reliability / durability: chemical, thermal and radiation resistance, thermal expansion management (induced stresses) ensure layer consistency, no cracking, metal free compositions with high aging resistance
- ⦿ Environment: non-toxicity (**RoHS** requirements, simple utilization)
- ⦿ Manufacturability: assembly ease; no special requirements for storage; low bond-line thickness & layer uniformity
- ⦿ Cost effectiveness: ensure low cost of material

RAY'S CONTRIBUTION

- Research in the field of ND laser synthesis: influence of synthesis parameters on ND characteristics and upgrading ND synthesis for project goals
- Development of ND surface modification, disaggregation in chosen solvents and producing ND dispersions in accordance with project tasks; adjusting ND dispersion technology for chosen polymers
- Characterization of ND compounds at partners' facilities
- Formulation of ND composite materials in accordance with project goals and technical requirements provided by responsible partners
- Process development for producing ND additives to TIMs and their handling
- Providing the partners with pure homogeneous ND powders, slurries and composites in accordance with their requirements

EXPECTED IMPACT

- ◉ Significant increase in the reliability and service life of power electronic devices and LEDs
- ◉ Significant decrease in cost
- ◉ Energy saving
- ◉ Increase in the competitiveness of EU manufacturers of PCB, LEDs and chemicals for electronics
- ◉ High increase in Global ND Market
- ◉ Creation of new workplaces



GLOBAL MARKET SIZE

- ◉ **The global PCB manufacturing market** according to Global Printed Circuit Board Market Analysis announced by Reportlinker.com is expected to increase from \$ 62.3 billion in 2013 to \$ 74.31billion in 2018.
- ◉ **The global adhesives market** according to the market research institute Ceresana is expected to generate revenues of \$50 billion in 2019.
- ◉ **The global fillers' market** according to Ceresana is expected to generate revenues of approx. \$27.7 billion in 2021. In 2013, Asia-Pacific was the worldwide largest sales market for fillers, accounting for 48% of total demand.
- ◉ **The main trends** confirmed by most market researchers are the using nano-fillers to adhesives for better thermal and stress resistance of PCB laminates and increase in PCB laminate prices.

RT PUBLICATIONS

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