Reactive NanoTechnologies

Leveraging Government, University and VC Funding to Bring a NanoTechnology to Market

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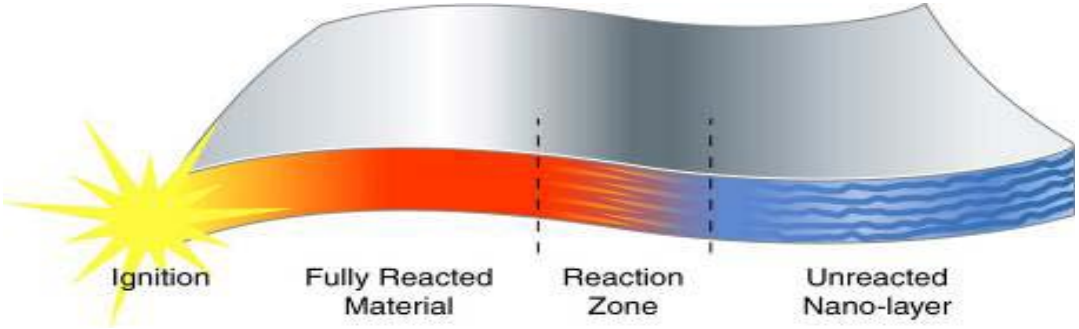
Presentation Outline

- Introduce NanoFoil and NanoBond
- RNT Products, and Applications
- Company Profile
- History: Technology, Company, Funding

NanoFoil®: The First and Only Nano-Engineered, Localized Energy Source

RNT manufactures NanoFoil® a platform technology that delivers energy in a controlled and precise manner.



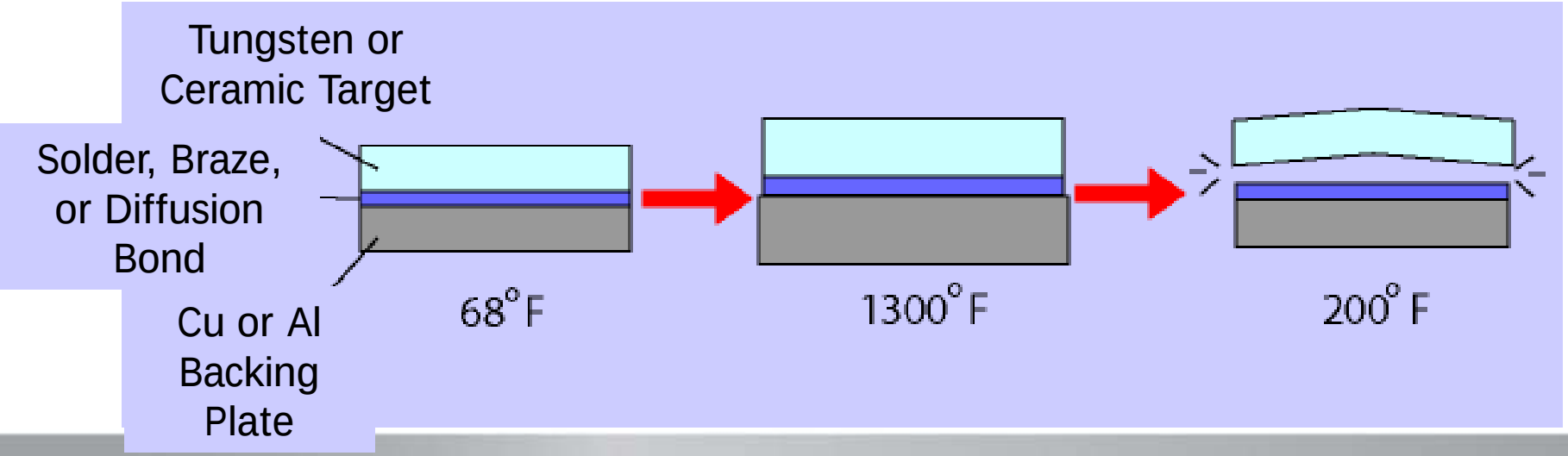
Revenue Model:

- RNT manufactures and sells NanoFoil®
Sell direct and through distributors

- RNT Sublicenses the right to use the foil (NanoBond®)

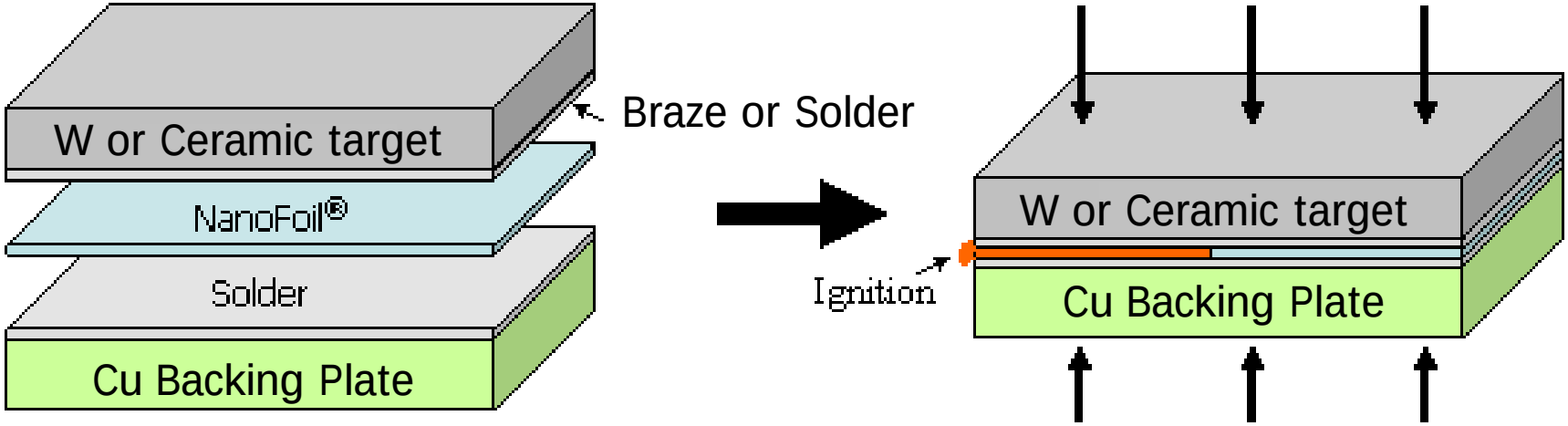
The Coefficient of Thermal Expansion (CTE) Challenge

- Many Metal/Metal and Metal/Ceramic pairs shrink at different rates on cooling
- Large thermal stresses develop when soldering, brazing or diffusion bonding dissimilar materials
- Warping and debonding of materials can occur



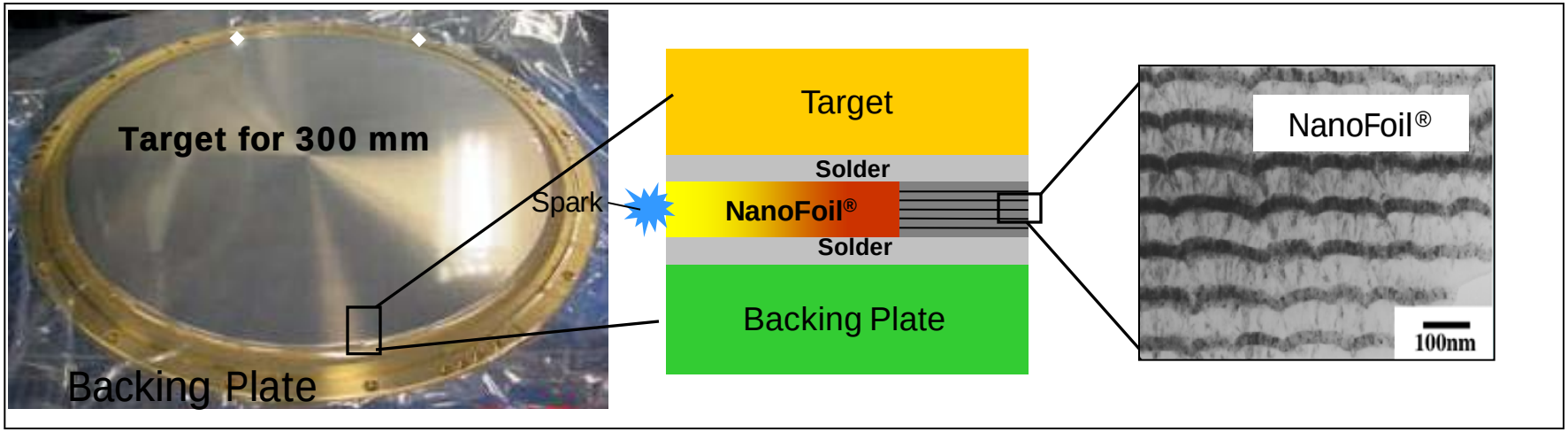
The NanoBond® Solution

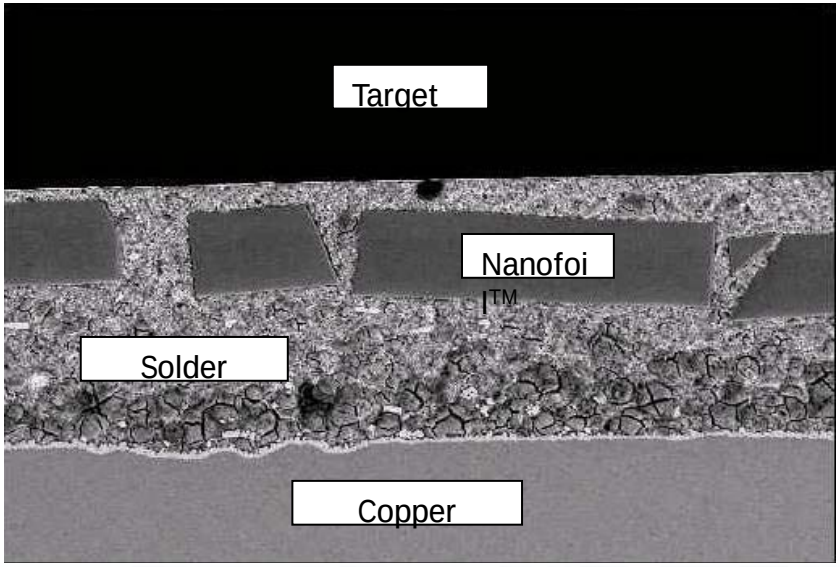
- Components are coated with solder or braze
- Insert NanoFoil® and apply pressure at room temperature
- Use heat from the NanoFoil® to melt solder or braze



A Foil Replaces the Furnace or Hotplate

The NanoBond Solution





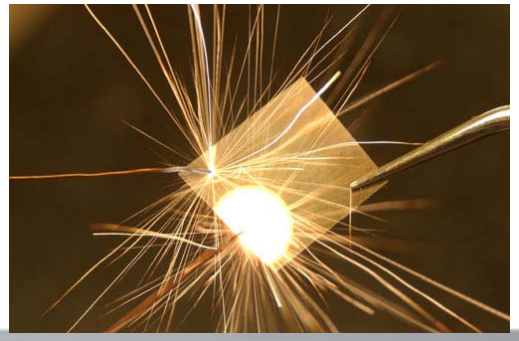
- No Thermal Damage of Materials
- Minimize Deflection or Cracking

RNT Focuses on Three Key Markets

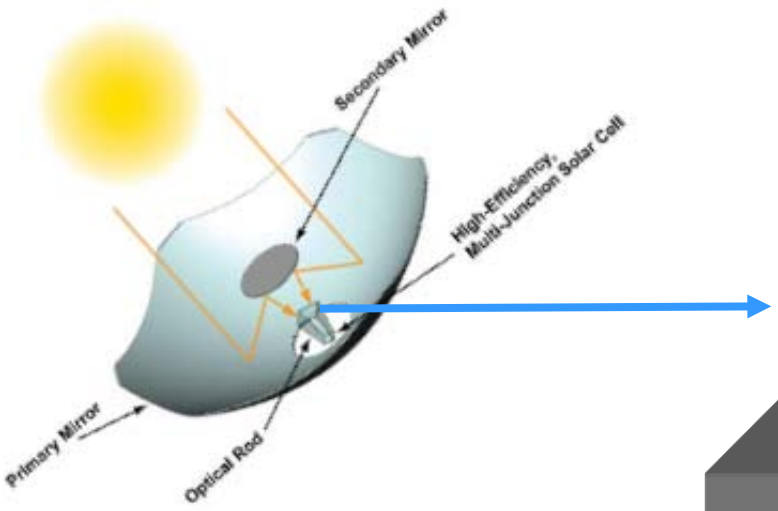
- **Sputter Target Bonding**
  - Metal to metal bonding
  - Metal to ceramic bonding
  - Currently serves planar target market, developing for rotatable target market

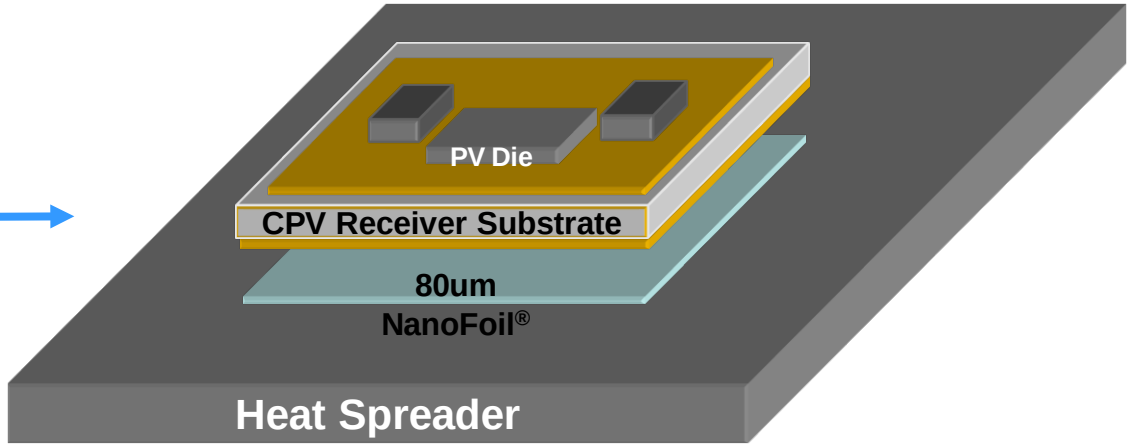
- **Electronic Assembly**
  - Thermally sensitive applications
  - Targeted applications
    - Manufacturer would prefer the strength of a soldered bond
    - Sole option in past has been to use adhesive technology

- **Energetics**
  - Ignition of flares or propellants
  - Green delays, detonators and fuses for explosives
  - Heat source for thermal batteries



Concentrated PV Application – Receiver Module Assembly





NanoBond® Advantages - In The System

- CPV operation with higher efficiency and reliability
- CPV operation at higher sun magnification

NanoBond® Advantages - In The Bond

- Thermal performance 6-10 times better than epoxy bonds
- True metallic bond without damaging exposure to solder reflow temperatures
- Low residual stress enabling superior metal-to-ceramic bonding

Company Profile

- Located in Hunt Valley, MD (just north of Baltimore)
  - Facility includes Production, Application Engineering, and R&D
- Experienced Management Team
  - RF Micro Devices, Heraeus, Denton Vacuum, Parker Hannifin, Johns Hopkins University
- Venture Financed (Credit Suisse, Siemens, Sevin Rosen, Toucan, SAS, DBED, etc)
- Producing and Selling NanoFoil® in multiple forms
- Acquisition by Indium Corporation of America
  - Sept 18, 2009
  - Excellent opportunity to leverage existing customer base and complementary products !!

History of Technology

- Lawrence Livermore National Lab (LLNL), mid 1990's
  - Initial development
  - Three patents filed
- Johns Hopkins University (JHU), 1995 - present
  - Significant additional development
  - Setup research group and collaborations (Professor Omar Knio, Professor Todd Hufnagel)
  - Multiple sources of research funding (NSF, ARL, 3M, TEDCO)
  - Five patents filed
- RNT has exclusive licenses from both entities

History of Company

- JHU Press Release in 1996 – Prof Tim Weihs
  - Covers the potential of use of foils for joining
  - Generates over 300 leads
  - Demonstrates real commercial interest but have proof of concept
- Corporate Requests 1999-2000
  - Agilent Technologies (funds development at JHU)
  - Requests to purchase foil
  - Dr. Tim Weihs decides to start company with Dr. Omar Knio
- Company Incorporated in 2001
  - Enter Emerging Technology Center's Incubator Program
    - John Fini (advisor)
    - Connected with people for legal, business, and financial advice
    - Learning as quickly as possible
  - Seek JHU and LLNL licenses

History of Funding

- Seed Money in 2001
  - Founders
  - TEDCO $50K Grant to JHU
- Series A in mid 2002
  - Raised $2M from Toucan Capital, SAS Investors, & MD-DBED
  - Won ~$4m in Gov't Grants - 1 NIST-ATP, 3 SBIRs (2 NSF, 1 Army)
  - $50K from TEDCO
- Series B in 2004
  - Raised $8M from Sevin Rosen, Toucan, SASI, etc.
  - Hired experienced CEO to bring forward commercialization
- Series C in 2007
  - Raised $17M from Siemens, Sevin Rosen, Credit Suisse
  - Additional $5M from Credit Suisse

Benefits of Early Government Funding

- The Insertions of New Materials often Takes 20 Years from Concept to Full Adoption (15 years so far)
  - Need to develop material and applications (multiple)
  - Customers are usually slow to put new materials into their production lines
  - Initial applications often do not work (air bag, heat sinks for CPUs and GPUs, propellant ignition)
  - Typical timeline is too long for VC-only funding
- Government Funding Supports Initial Development
  - NSF Grant #1 – lead to LED application
  - NSF Grant #2 – lead to sputter target application
  - Helped attract VC funding (B Round)
- Excellent opportunity…. But must be focused
  - Keep eye on commercialization… avoid becoming an SBIR-only company

Summary

- **Early government support was an absolutely critical part of making RNT a reality !!**
- **Early government support made early technical success made possible.**
- **The combination of government support and technical success made VC funding possible.**
- **VC funding provided the large dollars ($32M) needed to pursue commercialization.**
- **Early commercialization made a strategic acquisition possible.**
- **Note Of Caution !! Materials developments require patience and perseverance**
  - **Long insertion time for new materials**
  - **A materials start-up is a marathon not a sprint !!**