

Polymer Innovations, Inc.

Introduction:

Established in 1996

Polymer Innovations, Inc.

2426 Cades Way

Vista, CA 92081 USA

www.polymerinnovations.com

Phone: 760-598-0500

Introduction

- Polymer Innovations, Inc. (PII) is a relatively small company with a high percentage of scientists and engineers.
- PII is an Iso 9001 certified company dedicated to the manufacture of polymer based products related to tape casting and ceramic component manufacture.
- PII also provides a variety of services related to process and product development in similar areas.

Purchased New Facility 2005



- **Mark Wesselmann**, President – 1996
 - Mark@polymerinnovations.com
 - Academic background – Polymer Chemistry
 - R&D Manager Ferro 1986-1996 (passive component materials)
 - Solvent based tape casting and binders
 - Electrode pastes and vehicles
 - Termination pastes and vehicles
 - Beckman Instruments 1983-1986
 - Polymer resistor film and epoxy formulation
 - Dow Chemical 1979-1983
 - Styrenic polymer R&D

- **Kostadin Petkov**, Engineering Manager 1999
 - Kostadin@polymerinnovations.com
 - Academic background
 - Ceramic engineering
 - Chemical engineering
 - R&D Engineer at Institute of Technical Ceramics and Powder Metallurgy-Sofia Bulgaria.
 - Develop commercial ceramic processes for industry
 - Ceramic fabrication methods:
 - Injection molding
 - Powder pressing
 - extrusion
- **Rositsa Karshalev & Milena Pissarska**
 - Chemists with expertise in tape formulation and multilayer processing

Products

- Product main focus is organics used in ceramic processing
- Developed unique highest performing water based binder system WB4101
 - Used in commercial MLCC production since 1999
- Custom electrode pastes
- Electrode vehicles
- Termination vehicles
- Custom products containing polymers

Services

- Ceramic tape formulation services
- Tape Casting
- Lamination and firing capability
- Tape testing and characterization
- Paste Formulation
- Ceramic Process Support
- Development of product, process and prototype production

WB4101 Water Based Tape Casting Binder

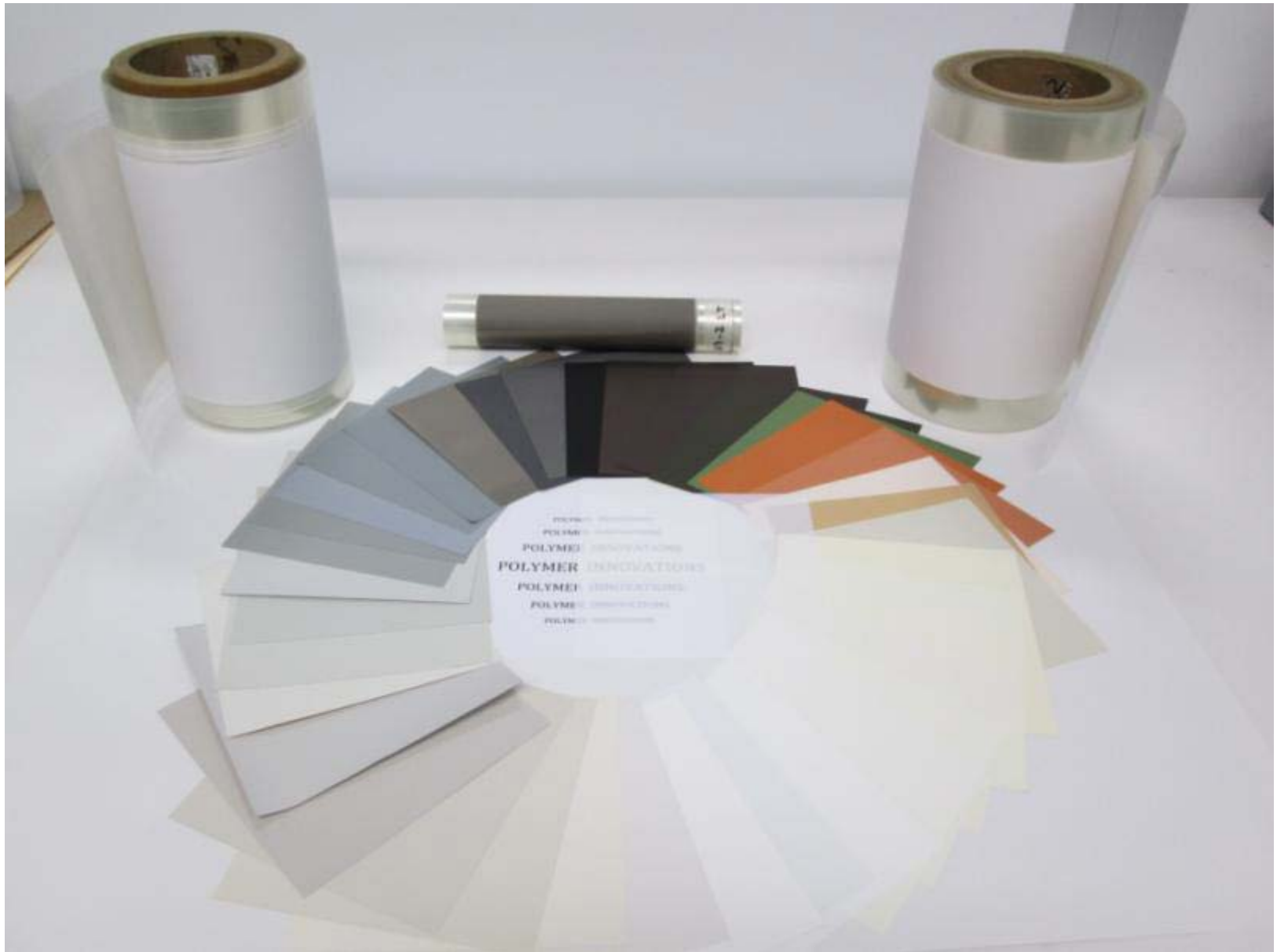
- Unique. Like no other water based binder
- Many statements and opinions regarding water based binder are not true with WB4101
- Not like emulsion or water soluble binders
- Chemically a very strong dispersant and binder – polymer is combination strong dispersing molecule and part strong binder molecule.
- Normally no added dispersant necessary but if used only PII compatible dispersants should be used.
- Some or all of the WB4101 should be present during the milling phase
- WB4101 should not be just mixed in stage 2 some milling is required (WB4101 is strong dispersant so competition for ceramic surface can result in non-optimum dispersion)

WB4101 (con't)

- Offers higher performance compared to common binders such as PVB or emulsion
 - Very high packing density and loading capable.
 - Cast from 2 microns to over 1000
 - Large temperature and processing window in regards to loading and lamination
 - Wide range of additives to adapt to many processes and powders
 - Nano powder superior performance

WB4101 (con't)

- Compared to PVB or emulsion
 - Typically higher packing density and stronger
 - Easier to laminate
 - Adaptable to more powders (see next slide):
 - Boron containing
 - MLCC: BT, MT, BME, COG, X7R, Y5V, high fire, mid fire, ultra low fire, nano
 - MLCI, PZT, LTCC, fuel cell, varistor
 - Metal powders/fibers, SiC
 - Oxide powders



- A recent photo we took showing the wide range of ceramics/metals and thicknesses we have cast with the WB4101 binder package.

WB4101 (con't)

- Non-flammable
- Yields water resistant tape but tape can be reworked with addition of ammonium hydroxide
- Clean up with dilute ammonium hydroxide
- Can be used with all water or mixed with water miscible solvents
 - IPA, Etoh, MEK, acetone, methyl acetate, etc.
- Additives:
 - Thick casting
 - Cast on steel belt or Mylar film
 - Modify adhesion to substrate

Electrode Vehicles and Pastes

- Just mill with metal powder to make printing pastes
- Low tape attack and distortion (wet and dry)
- Wide variety of drying rates
- Can design with thermoplastic tack
- Can be supplied with nano sintering control additive
 - Modify metal for better sintering match with ceramics, smoother and denser electrodes.

Termination Vehicles

- Capable of clean BBO in 0% O₂
- BME or air fire compatible
- VT06 vehicle
- TT01 thinner
- TX001 thixotrope and sinter modify
- TX003 totally organic thixotrope if desired

Tape Formulation Services

- Can take customer powder and other parameters and run many formulas for optimization
- Can supply formula and materials to customer
- Wide variety of powders and applications as mentioned earlier from MLCC to Fuel Cells
- Can produce certain prototype multilayer ceramic chips and structures.
- Full tape characterization
- Processes from milling, lamination, screen printing, cutting and firing in-house.

Tape Casting

- SiPET film caster
- 30 foot steel belt caster
- Cast from 2 to 500+ microns
- Water based casting