FIFTEENTH ANNUAL BiTS 2014 Burn-in & Test Strategies Workshop

Session 3

Tuesday 3/11/14 8:00am

SHOW THEM WHAT WE'RE MADE OF

Microelectronics continually tests the limits and ingenuity of test and burn-in strategies. So, more and more, the onus falls on materials solutions for sockets. This session kicks off with an examination of available socket materials to foster a better understanding of their relative merits for various applications, plus there's a sneak preview of coming material trends. The continuing trend of tighter pitches, higher temperatures and higher density contacts places heavy demands on test probes and equipment, particularly the materials used to manufacture them. As these materials continuously evolve, finite element modeling can help designers demonstrate the effects of material properties and performance as you'll learn in the second paper. The third presentation focuses on high temperature burn-in for automotive applications, emphasizing advancements in contact pin plating and surface finishing technologies to address the thermal challenges being faced. Wrapping up this session is a case study comparing three types of palladium alloys for spring pin contactors to determine what the best material is for test.

This Paper

The Stuff We're Made Of
An Examination of the State of the Art in Socket Materials
Jon Diller—Smiths Connectors | IDI

Rising to the Challenge: Material Evolution to Enable Reliable Performance at Tighter Pitches and Higher Temperature
Mike Gedeon—Materion

180 Deg. C BGA Burn-in, Is It Doable?
Kenji Ichihara, Masaru Sato, Noriyuki Matsuoka—Yamaichi Electronics Co., Ltd.
Jec Sangalang—Yamaichi Electronics USA

Palladium Alloy Hardening and Wear Away Characteristics
Takuto Yoshida, Craig Hudson—Test Tooling Solutions Group

The Stuff We're Made Of

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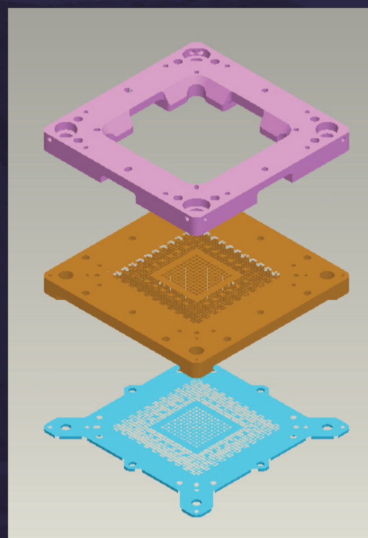
Jon Diller
Smiths Connectors | IDI

2014 BiTS Workshop
March 9 - 12, 2014

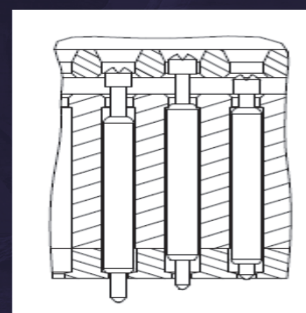
Contents

- Test contactor components
- Material characteristics
- Comparison of common thermoplastics
- Alternatives to plastic
- Heterogeneous contactors

Components



- Contactor body
- Retainer plate
- Alignment plate



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Desired Characteristics

- Socket body: Easy to machine precisely and dimensionally stable under load, contact friction, and environment
- Retainer plate: Resilient and dimensionally matched to body
- Alignment feature: Robust and precise

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Quantification

- Stiffness
- Hygroscopic growth
- Resistance to wear and impact
- Effects at high frequency

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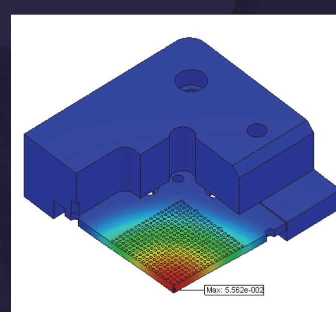
Stiffness

Material	Flexural Modulus of Elasticity
Torlon 4203	4213
Torlon 5530	6543
Vespel SCP-5000	5888
Semitron MDS-100	10686
Victrex Ceramic Filled PEEK	5936
Ryton PPS GF40%	6784
Victrex PEEK 450 GL30	6708
Test method ASTM D790, units Mpa, temp 23C	



Temp	SCP-5000	SP-1
23C	5760	3102
260C	3010	1724
Source: DuPont, 2014		

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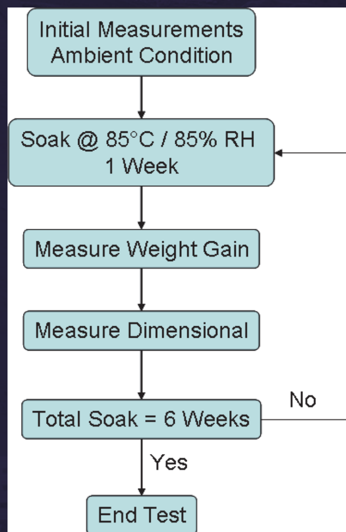
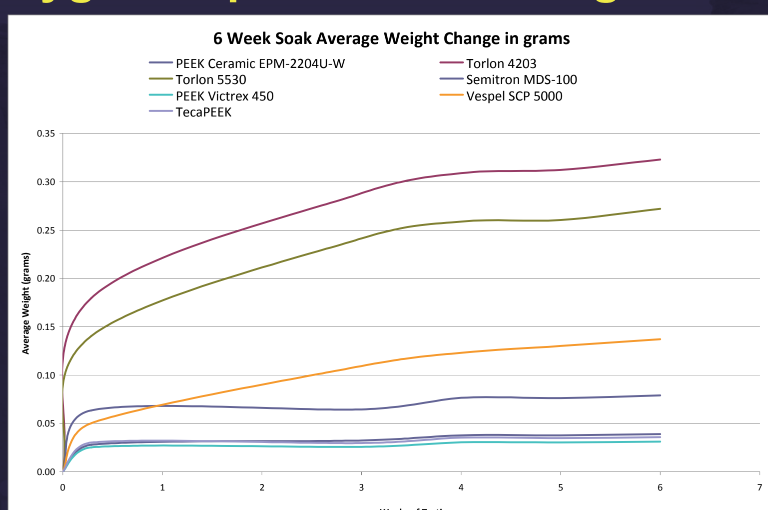
Hygroscopic Growth



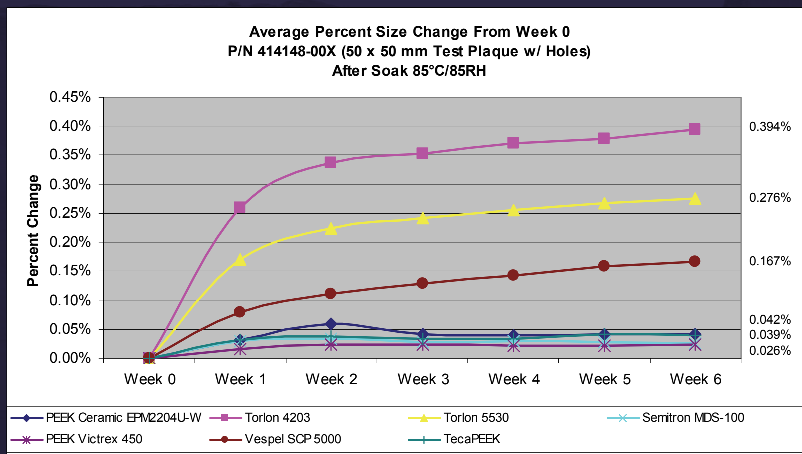
- **Data sheets dependent on abstract testing dissimilar from application**
- **Multi-axis evaluation permits best prediction of in situ behavior**

Hygroscopic Growth: Weight Gain



	PEEK Ceramic EPM-2204U-W	Torlon 4203	Torlon 5530	Semitron MDS-100	PEEK Victrex 450	Vespel SCP 5000	TecaPEEK
Max Change	0.0389	0.3231	0.2721	0.0789	0.0311	0.1370	0.0357

Hygroscopic Growth: Size



	PEEK Ceramic EPM2204U-W	Torlon 4203	Torlon 5530	Semitron MDS-100	PEEK Victrex 450	Vespel SCP 5000	TecaPEEK
Max	0.059%	0.394%	0.276%	0.033%	0.023%	0.167%	0.042%

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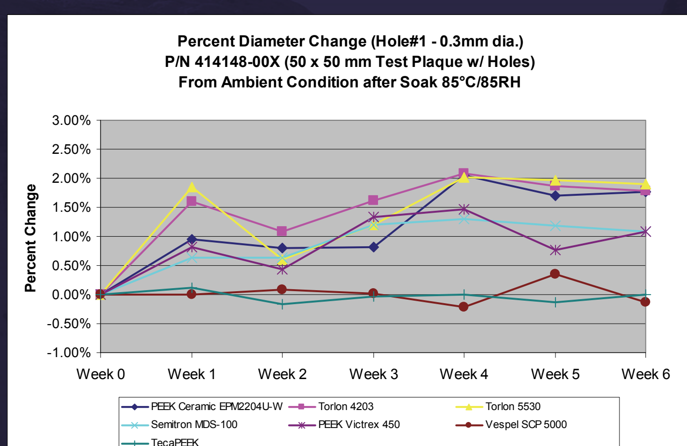
Hygroscopic Growth: Small Isolated Hole



	PEEK Ceramic EPM2204U-W	Torlon 4203	Torlon 5530	Semitron MDS-100	PEEK Victrex 450	Vespel SCP 5000	TecaPEEK
Max	2.05%	2.08%	2.01%	1.29%	1.46%	0.36%	0.11%

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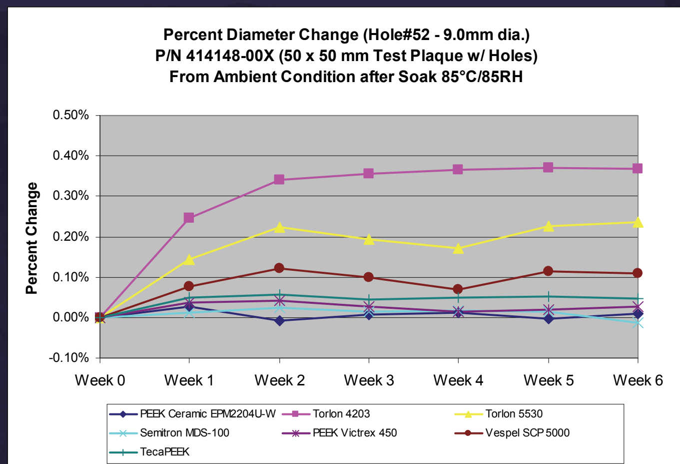
Hygroscopic Growth: Big Hole ⦰



	PEEK Ceramic EPM2204U-W	Torlon 4203	Torlon 5530	Semitron MDS-100	PEEK Victrex 450	Vespel SCP 5000	TecaPEEK
Max	0.03%	0.37%	0.24%	0.02%	0.04%	0.12%	0.06%

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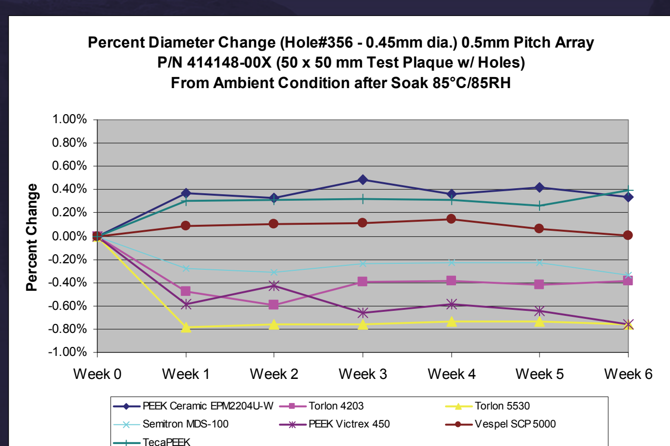
Hygroscopic Growth: Small Array Hole ⦰



	PEEK Ceramic EPM2204U-W	Torlon 4203	Torlon 5530	Semitron MDS-100	PEEK Victrex 450	Vespel SCP 5000	TecaPEEK
Max	0.49%	-0.59%	-0.79%	-0.34%	-0.76%	0.14%	0.39%

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Paper #1
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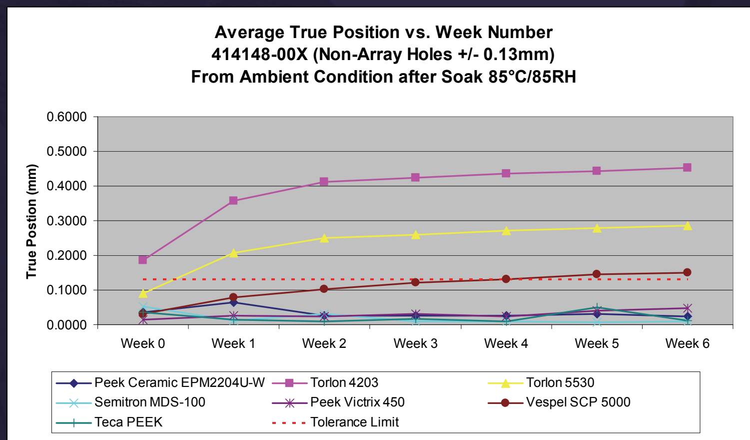
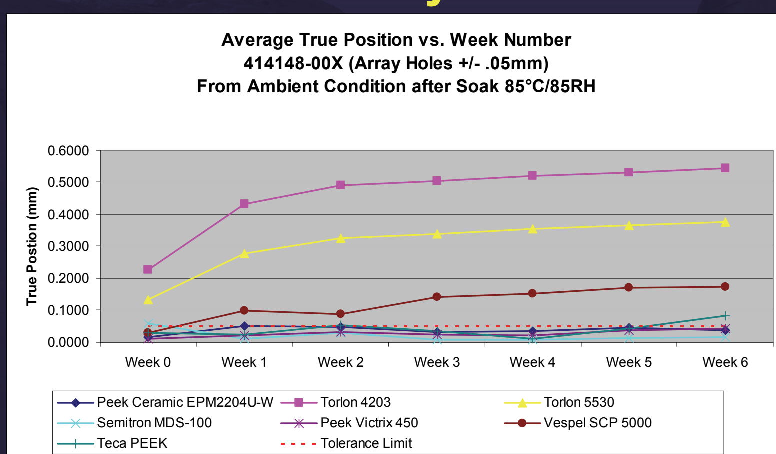
Hygroscopic Growth: True Position Non-Array



	Peek Ceramic EPM2204U-W	Torlon 4203	Torlon 5530	Semitron MDS-100	Peek Victrix 450	Vespel SCP 5000	Teca PEEK
Max	0.0640	0.4533	0.2858	0.0522	0.0465	0.1495	0.0490

Hygroscopic Growth: True Position Array



	Peek Ceramic EPM2204U-W	Torlon 4203	Torlon 5530	Semitron MDS-100	Peek Victrix 450	Vespel SCP 5000	Teca PEEK
Max	0.0514	0.5438	0.3756	0.0588	0.0424	0.1729	0.0817

Resistance to Wear

- 775 pin BGA socket tested through 100K insertions at 25° and 120°
- 0.2 bias toward East wall
- Distance E-W measured over cycles

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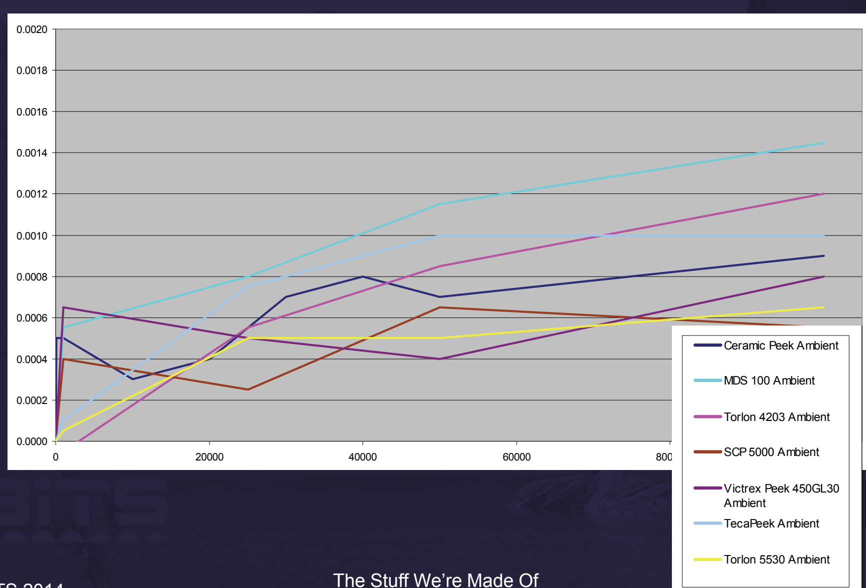
Resistance to Wear: 25°



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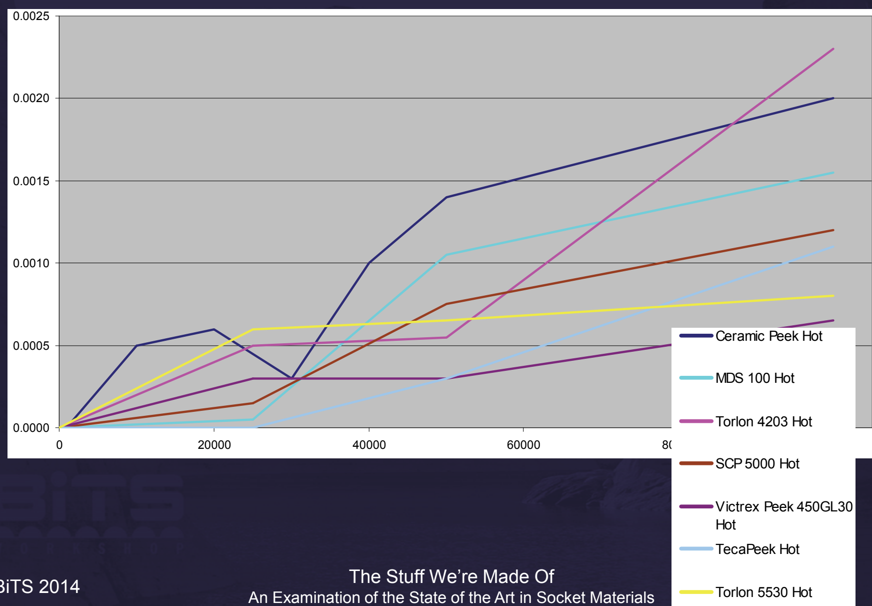
Resistance to Wear: 120°



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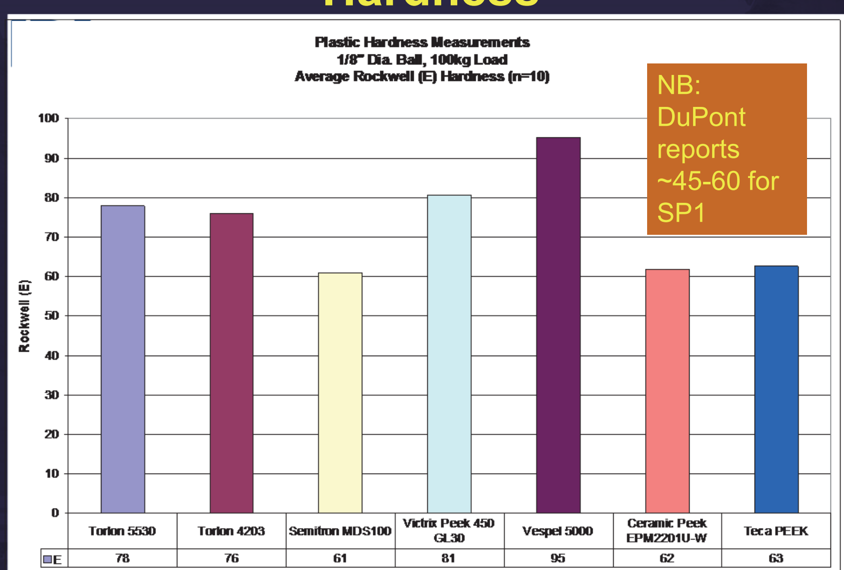
Hardness



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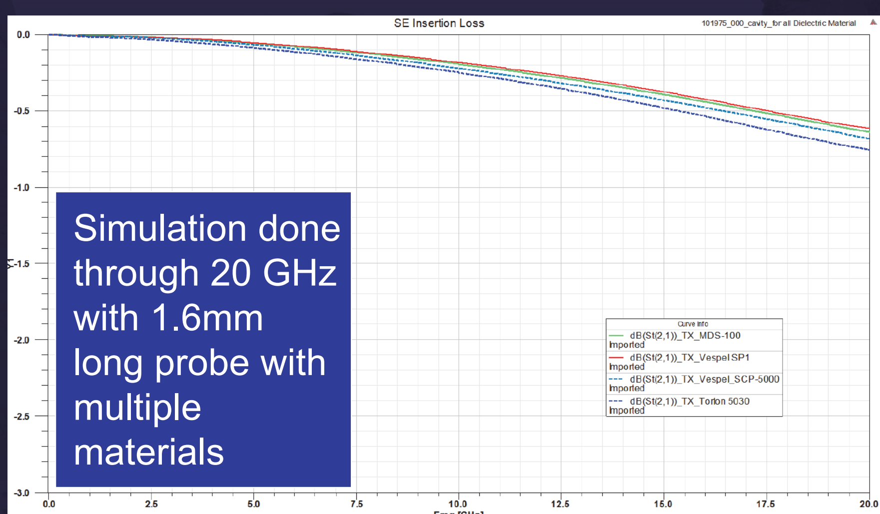
High Frequency

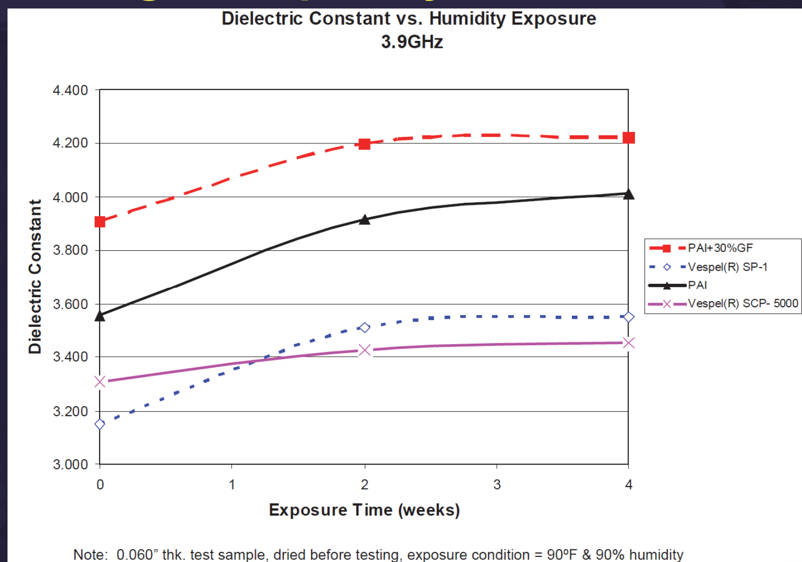
Material	Relative Permittivity	Dissipation Factor
Ceramic Peek EPM-2204U-W	4.19	0.011
Victrix Peek 450-GL30	3.45	0.012
Semitron MDS-100	3.08	0.012
Sumika S1000	2.89	0.013
Torlon 4203	3.30	0.020
Torlon 5530	3.53	0.020
Vespel SCP5000	2.98	0.011

- S parameters of 3 & 5” traces measured at 5 GHz
- Fitted to model in ADS
- Delta Dε = 4Ω difference in Zo cPEEK v. 5530
- High dissipation factor of Torlons significant >10 GHz

High Frequency



High Frequency: Dε vs. H2O



Note: 0.060" thk. test sample, dried before testing, exposure condition = 90ºF & 90% humidity

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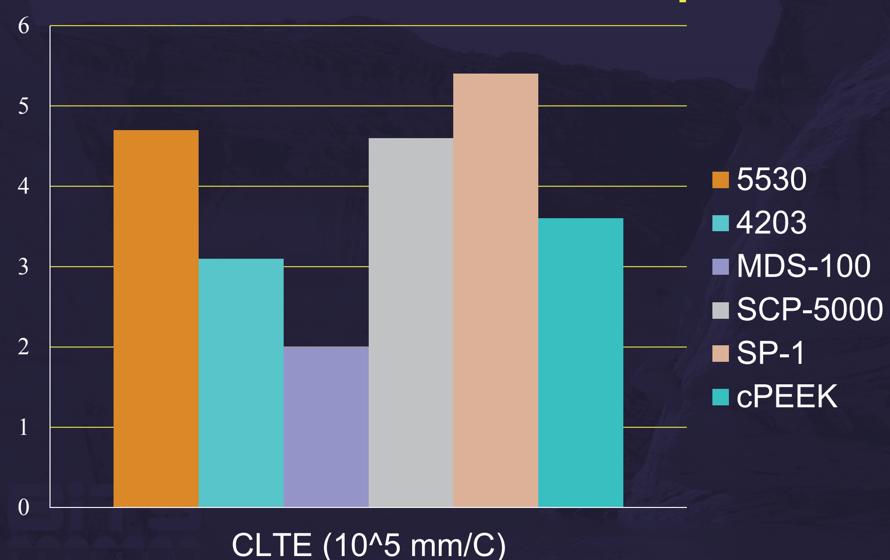
Coefficients of Thermal Expansion



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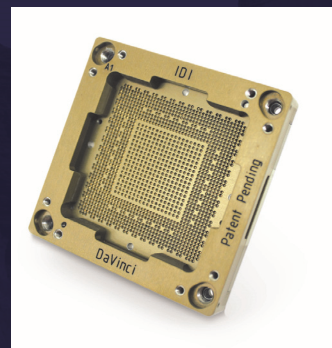
Alternatives: Insulated Metal

- Wear-resistant
- Non-hygroscopic
- Stiffest
- Thermally conductive
- Only coaxial



Properties (MPa)	IM	Ceramic Peek	Semitron MDS 100	Torlon 4203
Elastic Modulus	70300	4482	10340	5000
Tensile Yield Strength	193	90	101	192

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Alternatives: Machinable Ceramic

- Stiff and deformation resistant
- Non-Hygroscopic
- Wear-resistant
- Abrasive
- Brittle

Property	Value	NBpE	NBpE Value
Elastic Modulus	157	MDS-100	11
CLTE	1.4	MDS-100	2.0
Hardness	230 HV	N/C	N/C
Dε	5.5	SCP-5K	3.0

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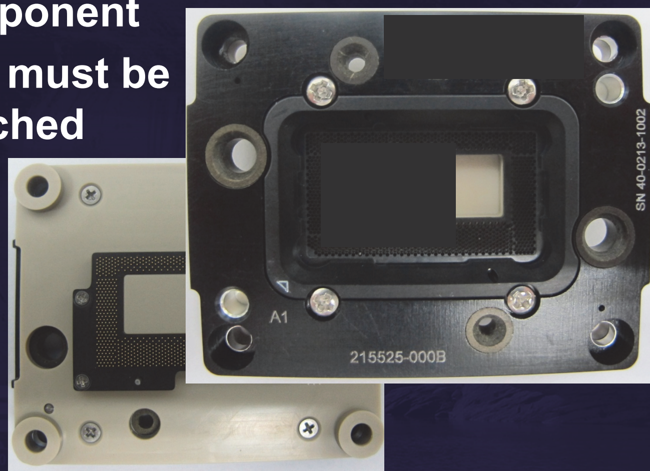
Heterogeneous Contactors

- Properties appropriate to each component
- CTE must be matched



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Acknowledgements

- Lindsay Overton, DuPont
- IDI Test Laboratory and Design Engineering group, particularly:
  - Kiley Beard
  - Kevin DeFord
  - Dr. Frank Zhou
  - Dr. Ron Meek (emeritus)

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