Curvite™ "Bio Sugar Carbon"

A Family of Low Porosity, Functionalized, Carbon Micro-Powders Derived from Natural Sugars

Allen D. Clauss, Ph.D.
President
CTI Consulting, LLC

C T I
Creative Technical Insight
CONSULTING

Curvite™ "Bio Sugar Carbon"

A Family of Low Porosity, Functionalized, Carbon Micro-Powders Derived from Natural Sugars

- Patent Pending
  International patent application published 25 February 2021.
  Favorable International Search Report indicating allowable claims.

- Derived from natural hexose sugars in a simple, single-step, dehydration reaction providing a sustainable, low cost, carbon-neutral route.

- Low porosity and platelet morphology with gentle, random, curvature that make the particles resistant to agglomeration and therefore readily dispersible in polymer and other host matrices.

- Can be prepared with a wide range of oxygen functionalization that allows for optimization of interfacial stability and functional properties (e.g., mechanical properties, thermal properties) in various polymer and other host matrices.

- Can be readily dispersed in thermosetting and thermoplastic polymer resins at loadings of ca. 5% to 40% providing significant increases in storage modulus and glass transition temperature.

C T I
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

Patent Pending - International Patent Application Published 25 February 2021

Favorable International Search Report Indicates Substantial Allowable Claims

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 February 2021 (25.02.2021)

WIPO | PCT

(10) International Publication Number
WO 2021/034900 A1

(51) International Patent Classification:
C01B 32/00 (2017.01) *C09C 1/48* (2006.01)
C01B 32/15 (2017.01) *F28F 21/02* (2006.01)
C09C 1/44 (2006.01) *H01B 3/18* (2006.01)
C09C 1/46 (2006.01)

(21) International Application Number:
PCT/US2020/046933

(22) International Filing Date:
19 August 2020 (19.08.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/889,261 20 August 2019 (20.08.2019) US

(71) Applicant: **CTI CONSULTING, LLC** [US/US]; 1 Parklawn Place, Madison, Wisconsin 53705 (US).

(72) Inventor: **CLAUSS, Allen D.**; c/o CTI Consulting, LLC, 1 Parklawn Place, Madison, Wisconsin 53705 (US).

(74) Agent: **JONES, J. Mitchell**; Casimir Jones, S.C., 2275 Deming Way, Ste 310, Middleton, Wisconsin 53562 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

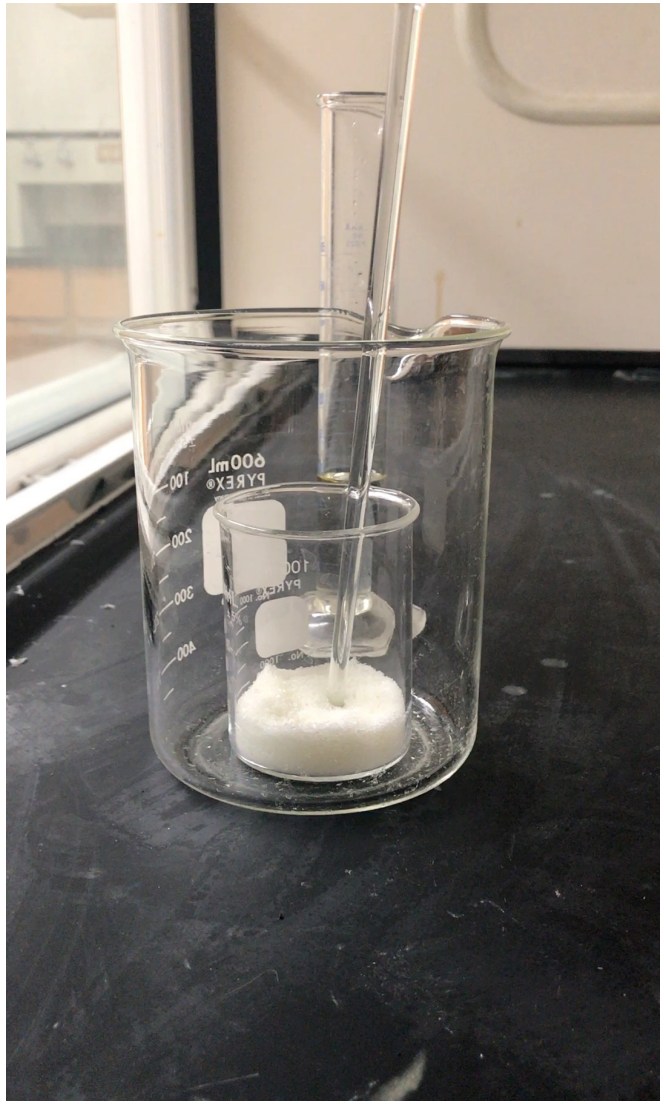
Published:
— *with international search report (Art. 21(3))*

(54) Title: LOW POROSITY, FUNCTIONALIZED, CARBON MICRO-POWDERS

CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

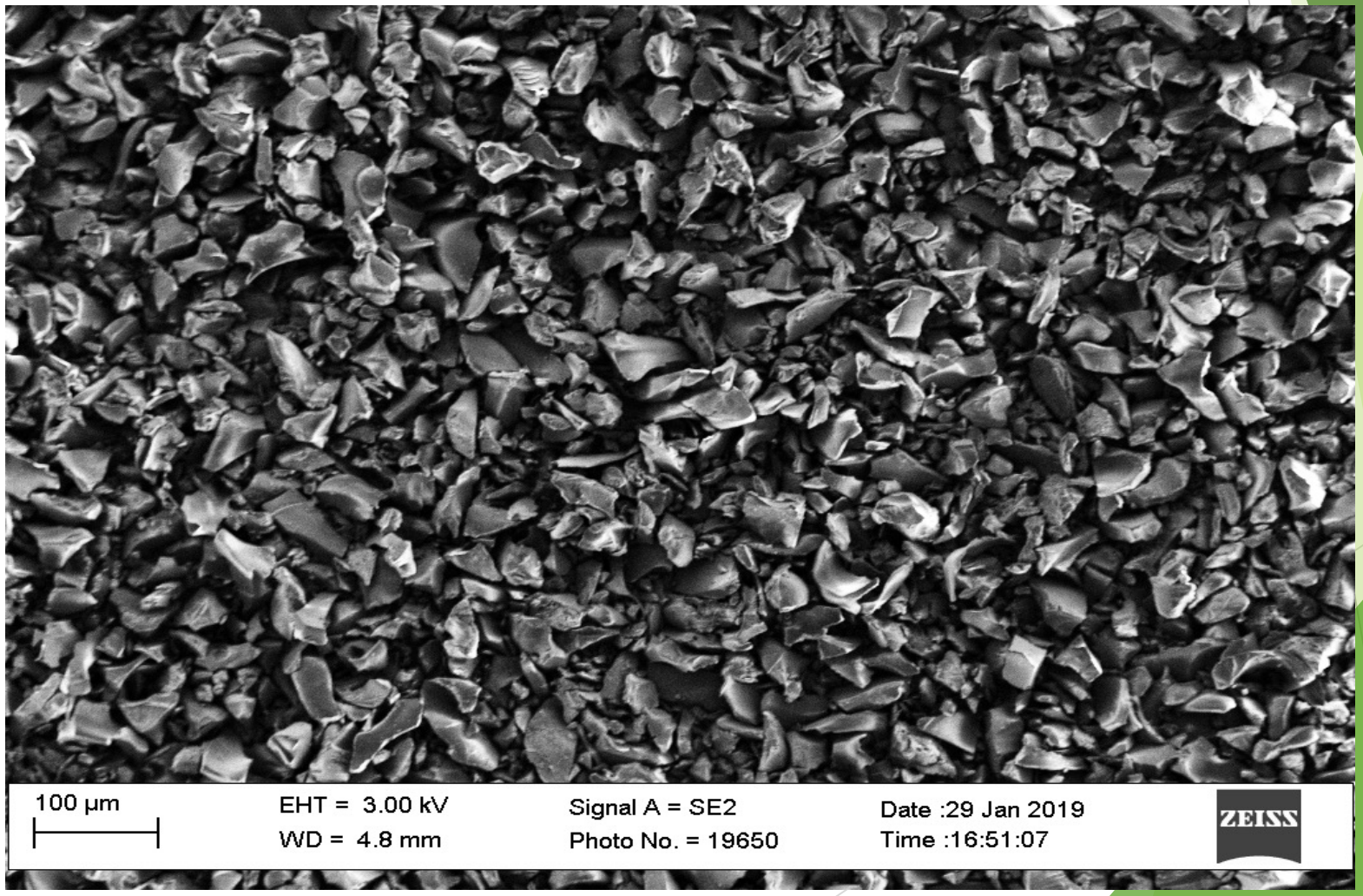
Derived from natural hexose sugars in a simple, single-step dehydration reaction providing a sustainable, low cost, carbon-neutral route.



CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

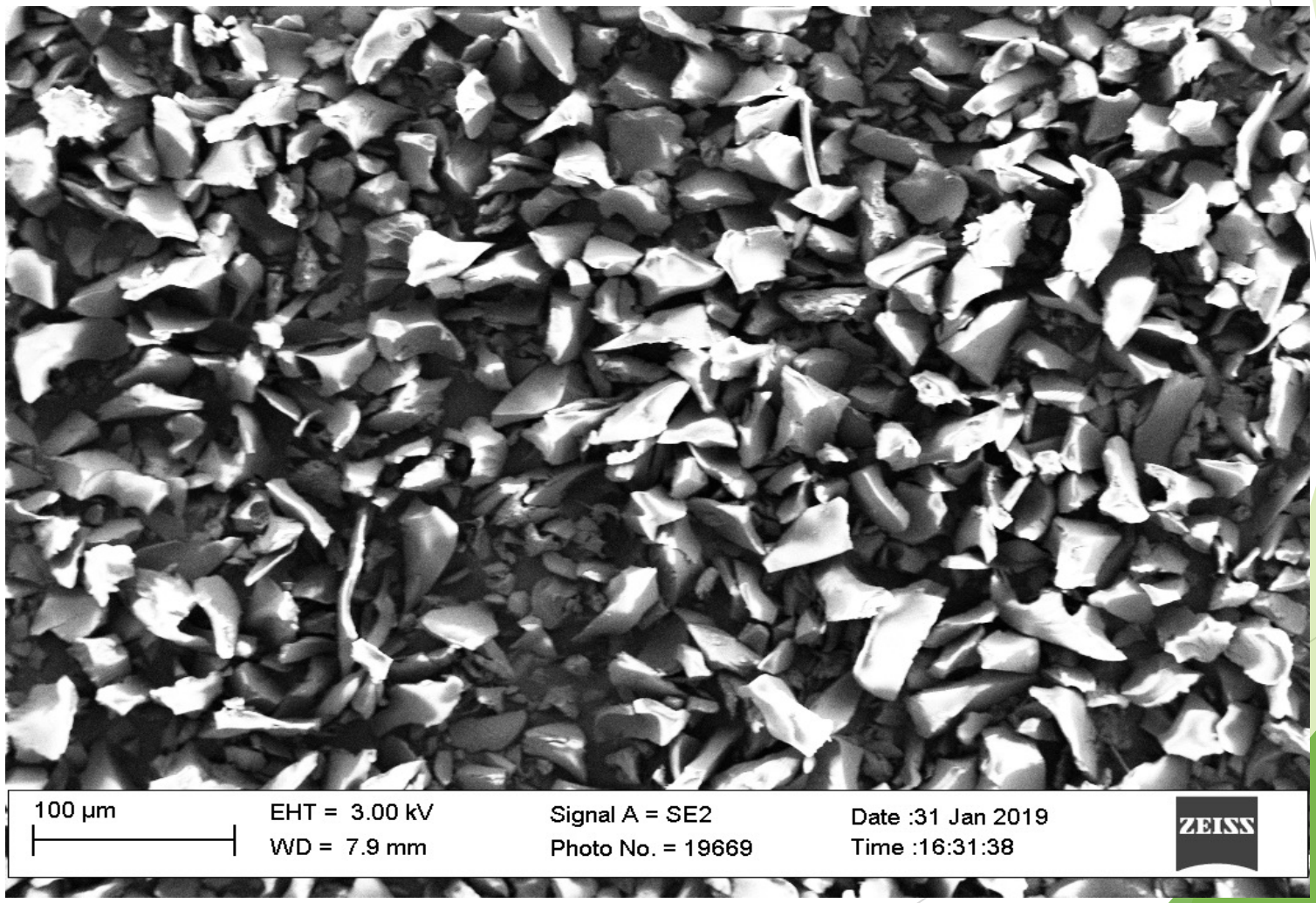
Low porosity and platelet morphology with gentle, random curvature that make the particles resistant to agglomeration and therefore readily dispersible in polymer and other host matrices. (150X Magnification)



CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

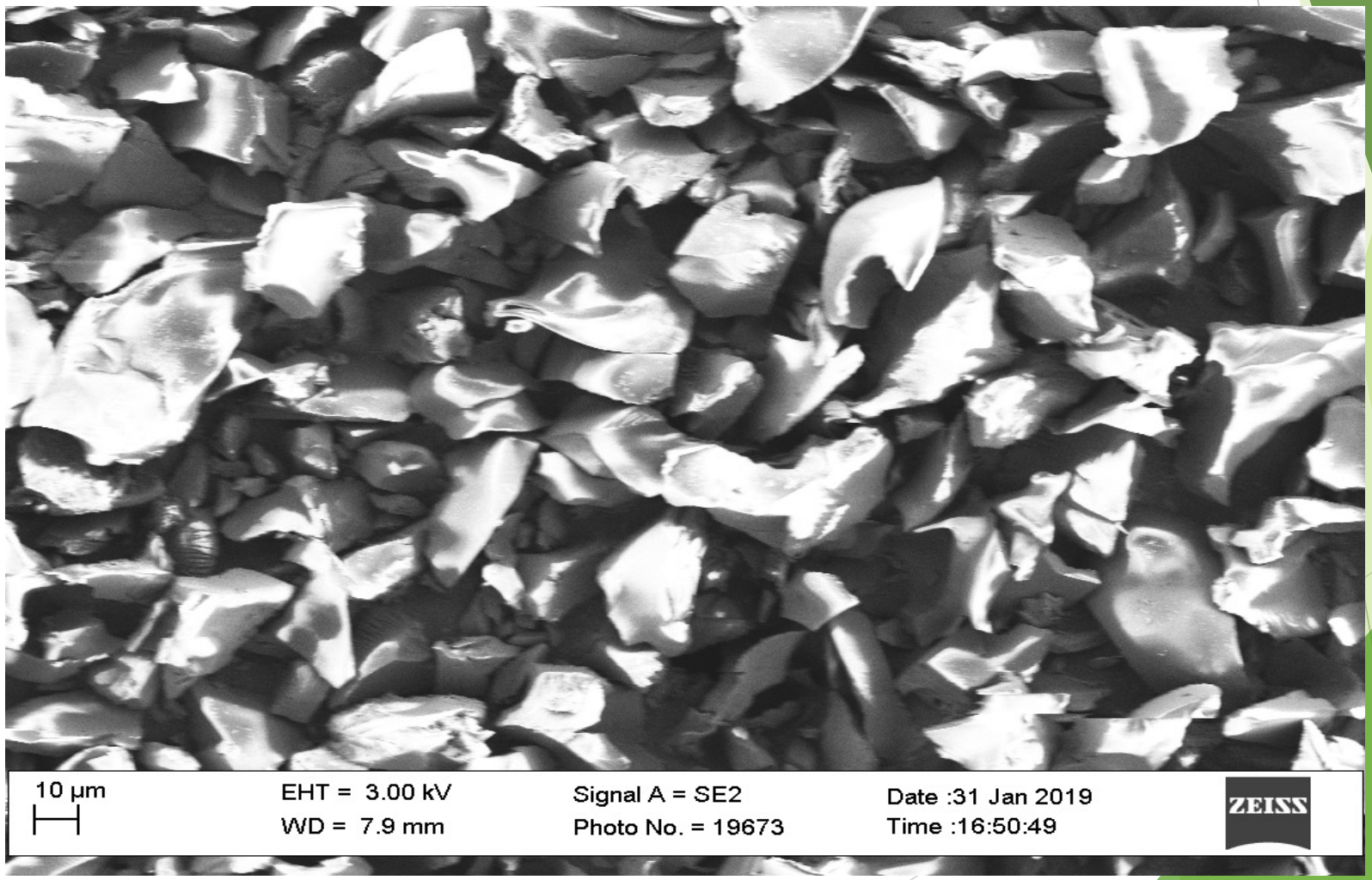
250X Magnification



CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

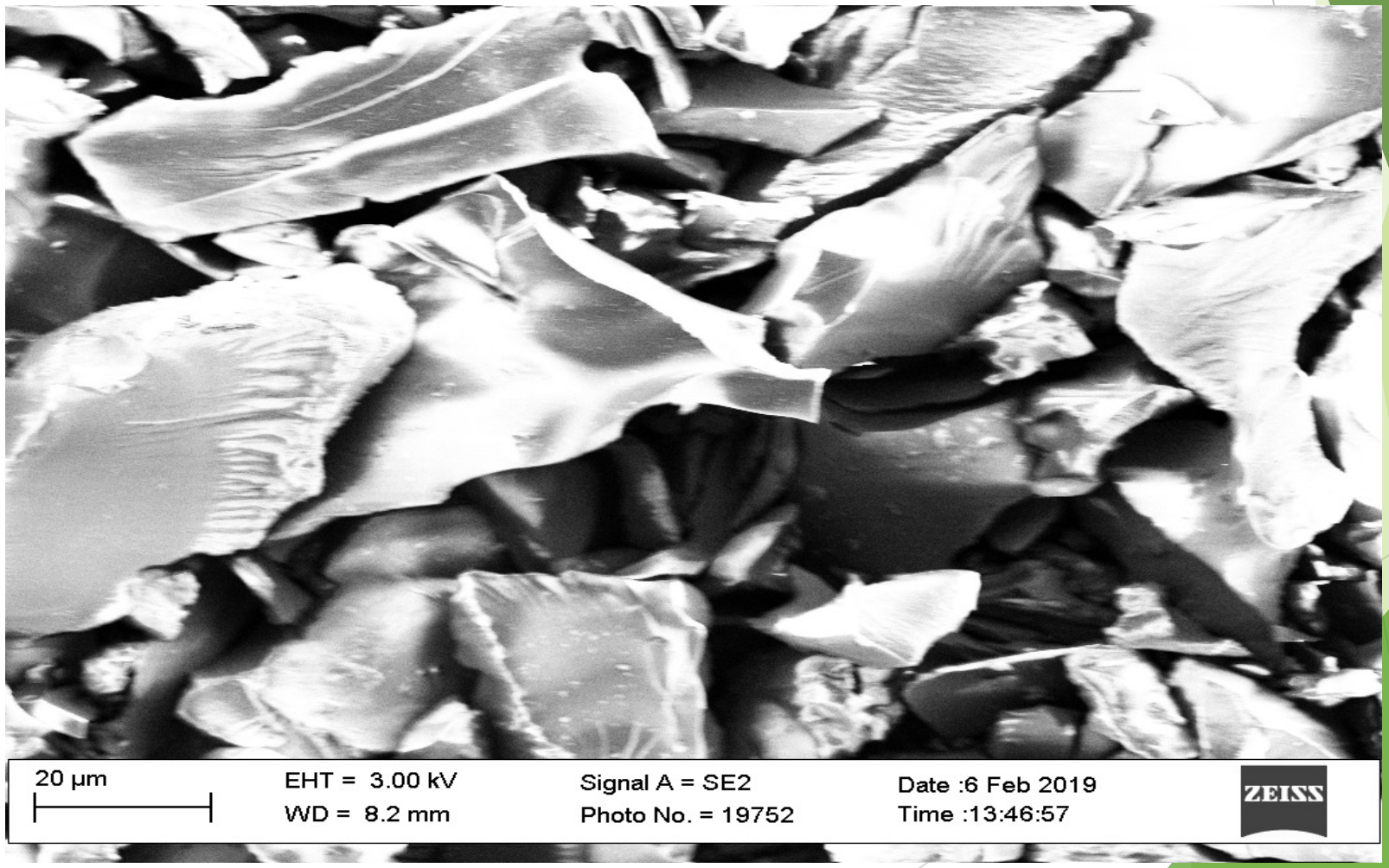
500X Magnification



CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

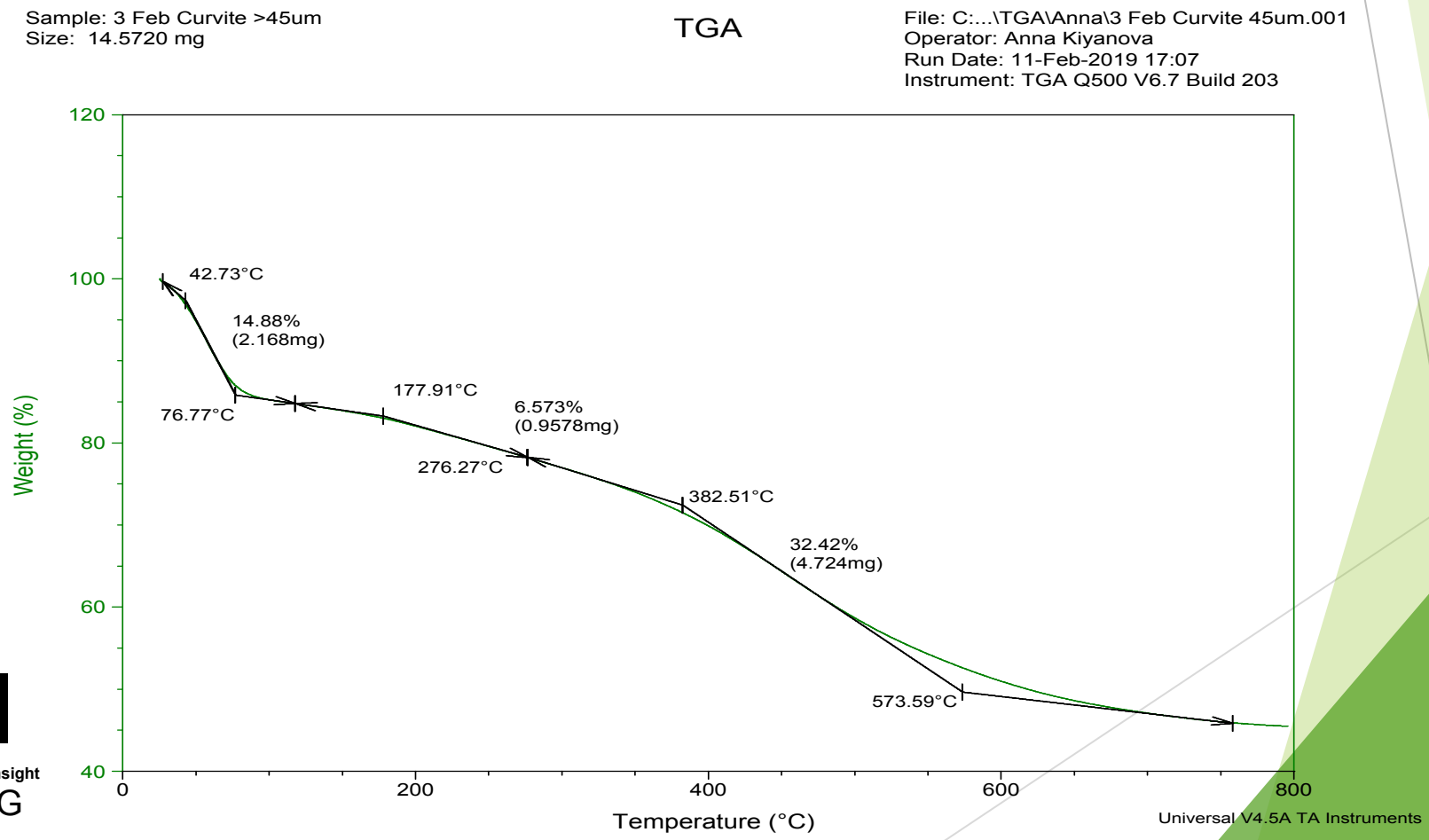
1,000X Magnification



CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

Can be prepared with a wide range of oxygen functionalization that allows for optimization of interfacial stability and functional properties (e.g., mechanical properties, thermal properties) in various polymer and other host matrices.



CTI
Creative Technical Insight
CONSULTING

Curvite™ "Bio Sugar Carbon"

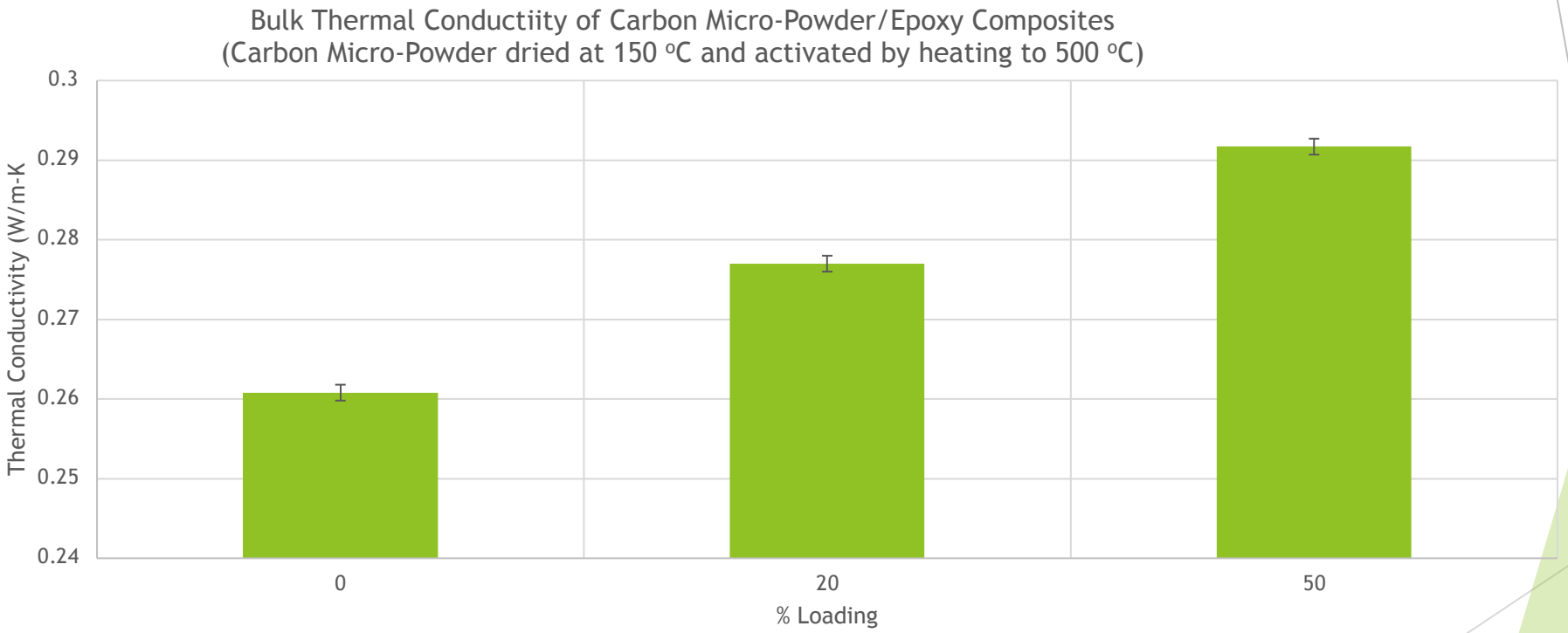
Can be prepared with a wide range of oxygen functionalization that allows for optimization of interfacial stability and functional properties (e.g., mechanical properties, thermal properties) in various polymer and other host matrices.

Drying Condition	%C	%O	%H	%S
150 °C (open atmosphere)	67.11	28.99	2.69	0.082
500 °C (open atmosphere)	73.65	22.69	2.68	
500 °C (nitrogen atmosphere)	75.57	19.66	2.42	
600 °C (nitrogen atmosphere)	86.62	8.81	2.55	

CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

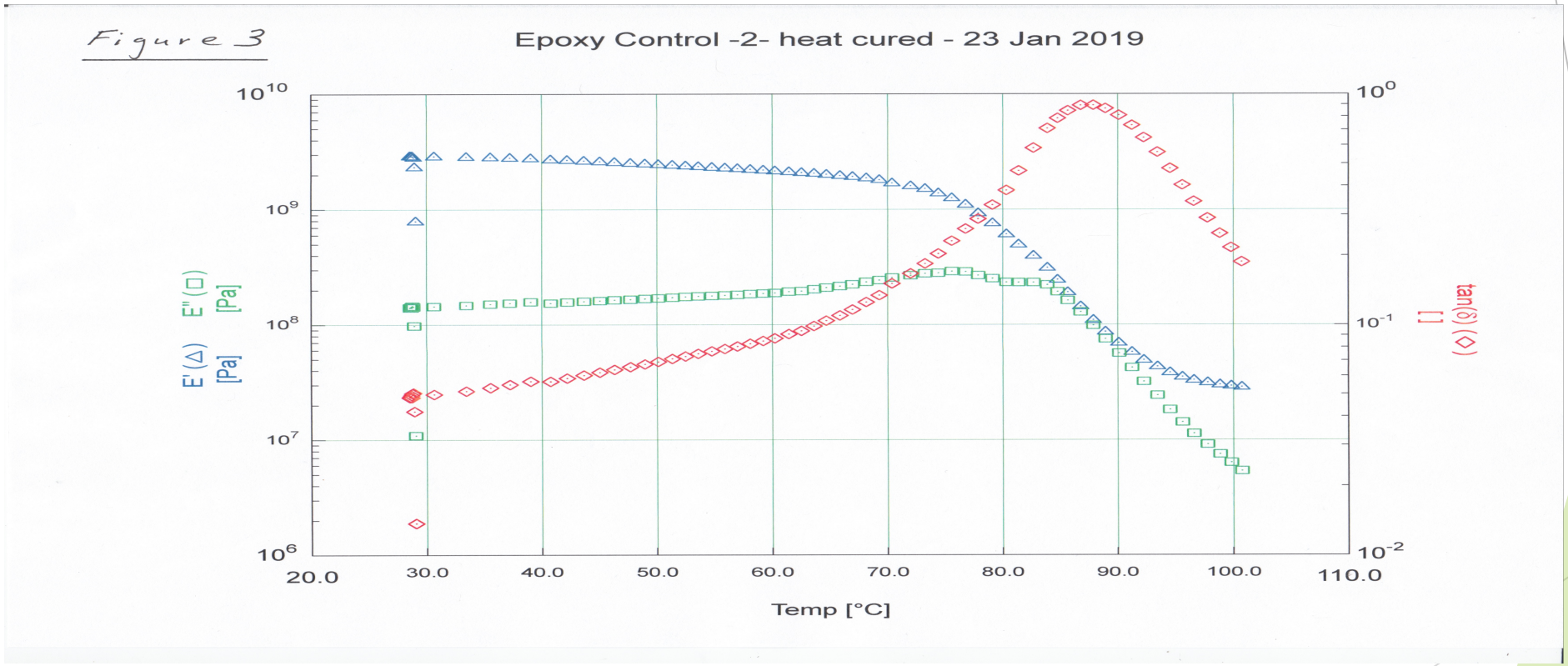
Can be prepared with a wide range of oxygen functionalization that allows for optimization of interfacial stability and functional properties (e.g., mechanical properties, thermal properties) in various polymer and other host matrices.



CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

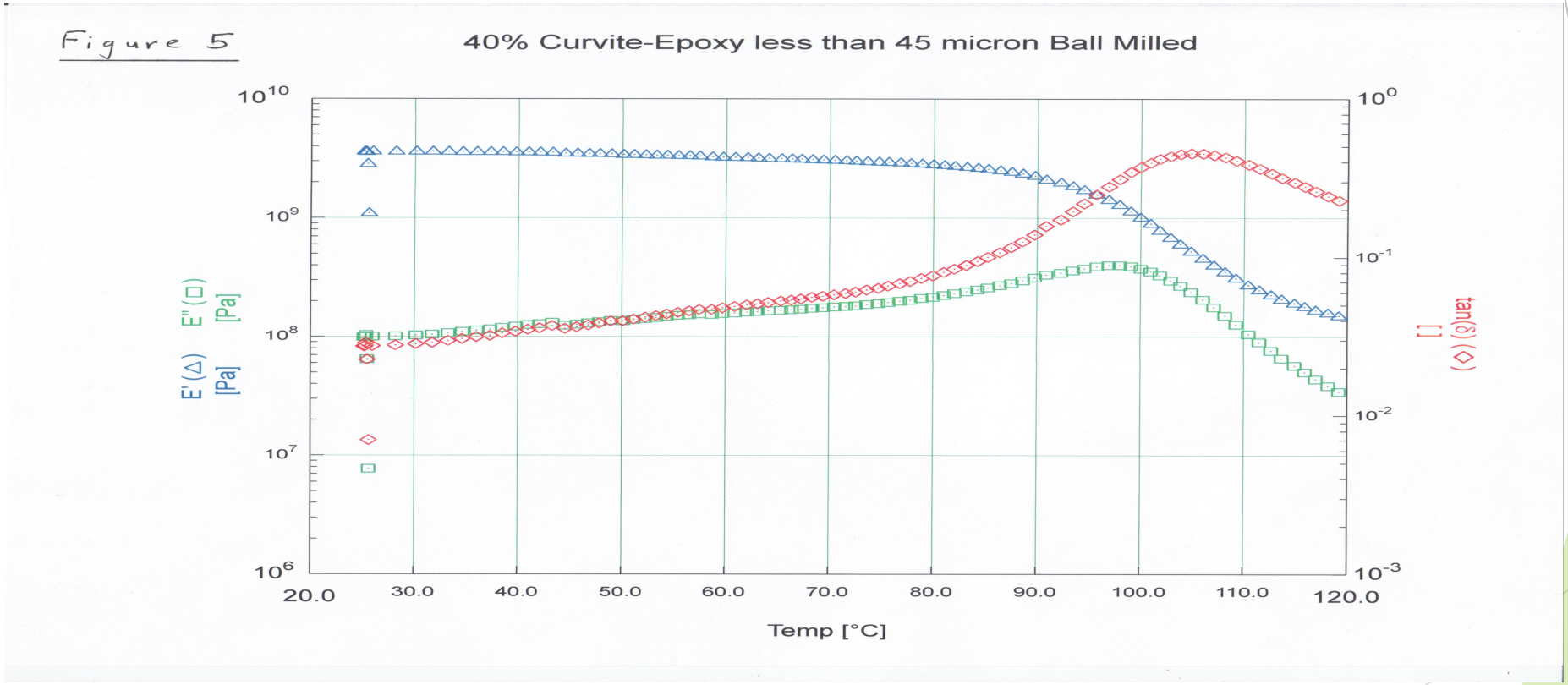
Can be readily dispersed in thermosetting and thermoplastic polymer resins at loadings of ca. 5% to 40% providing significant increases in storage modulus and glass transition temperature.



CTI
Creative Technical Insight
CONSULTING

Curvite™ “Bio Sugar Carbon”

Can be readily dispersed in thermosetting and thermoplastic polymer resins at loadings of ca. 5% to 40% providing significant increases in storage modulus and glass transition temperature.



CTI
Creative Technical Insight
CONSULTING

Curvite™ "Bio Sugar Carbon"

Potential Commercial Applications of Curvite™

- Paritial or complete replacment of petroleum-based carbon black in elastomers providing a sustainable zero net carbon replacement with improved performance properties (e.g. improved wear resistance, high temperature stability)

  - Tires
  - Seals and Gaskets
  - Brake Linings
  - Drive Belts
  - Many other Elastomers

- Functional filler in petroleum-based thermosetting and thermoplastic polymer resins, replacing petroleum-derived carbon black and partially replacing carbon fiber, providing a zero net carbon replacement with improved performance properties
  - High Strength, Light Weight Epoxy/Carbon and Unsaturated Polyester/Carbon Composites
  - Polyamide/Carbon and ABS/Carbon Composites

CTI
Creative Technical Insight
CONSULTING

Curvite™ "Bio Sugar Carbon"

Potential Commercial Applications of Curvite™

- Zero net carbon additive filler for readily biodegradable plant-based biopolymers providing improved mechanical and thermal properties comparable to petroleum-based polymers

  - Bio-polymers/Plastics (e.g. Polylactic Acid, Polyhydroxyalkanoate) as replacement for polypropylene, polyethylene, or PET in wide range of applications
  - Bio-paints and Coatings
  - Bio-rubber
  - Many other Bio-specialty Polymers

CTI
Creative Technical Insight
CONSULTING

Curvite™ "Bio Sugar Carbon"

A Family of Low Porosity, Functionalized, Carbon Micro-Powders Derived from Natural Sugars

Allen D. Clauss, Ph.D.
President
CTI Consulting, LLC

C T I
Creative Technical Insight
CONSULTING