

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

(19) World Intellectual Property
Organization
International Bureau

(43) International Publication Date
18 April 2024 (18.04.2024)



(10) International Publication Number
WO 2024/080925 A2

(51) International Patent Classification:

C01B 32/05 (2017.01) *B29C 35/02* (2006.01)
C08F 120/30 (2006.01) *B29C 71/02* (2006.01)
C08L 33/14 (2006.01) *B33Y 70/00* (2020.01)
C08F 2/50 (2006.01) *B33Y 80/00* (2015.01)
B29C 64/135 (2017.01)

(21) International Application Number:

PCT/SG2023/050680

(22) International Filing Date:

09 October 2023 (09.10.2023)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

10202251319A 10 October 2022 (10.10.2022) SG

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(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, CV, CZ, DE, DJ, DK, DM,

(54) Title: METHOD OF PRECISION 3D PRINTED GLASSY CARBON

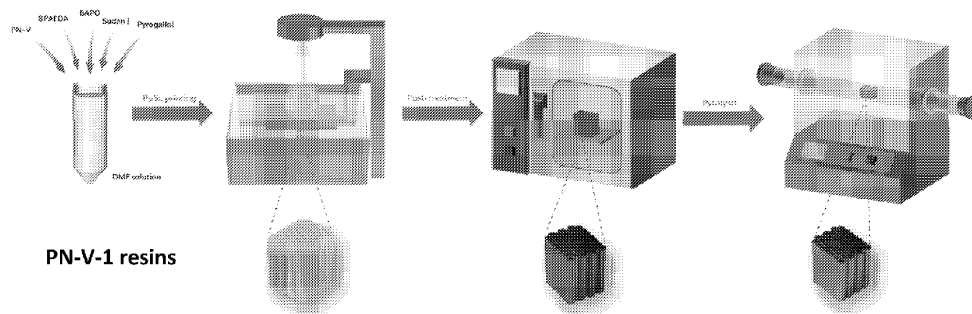


FIG. 9

(57) **Abstract:** Disclosed herein are the synthesis and characterisations of the monoacrylate-functionalised phthalonitriles (PNs) Their chemical structures are verified with 1H nuclear magnetic resonance (NMR) and Fourier transform infrared (FT-IR) spectra to confirm the successful synthesis. Subsequently, photopolymerisable resins, based on the prepared PN monomer, a commercial diacrylate and other additives can be formulated. Being post thermally treated, the PN based resins result in polymeric products with excellent thermal and mechanical performances, suggesting the high-performance nature of the PN based resins. Interestingly, the resins exhibit significant high carbon yield, indicating that they are greatly promising candidates as carbon precursors. As it is found that the resins have good three-dimensional (3D) printing capability and can be fabricated using high-resolution projection micro- stereolithography (PμSL) additive manufacturing technology, complex 3D structured objects are herein printed and performed follow-up post treatment. After being progressively pyrolysed up to 1000 °C, the printed objects can be readily converted to glassy carbon (GC) structures with structural integrity and fidelity. Only ~25% of shrinkage was found for the converted GC structure due to the significantly high char yield of the PN resins. This work not only expands the library of new class of high-performance PN resins for popular additive manufacturing but also features the precision 3D printing of GC with low shrinkage and high carbon yield for the first time.

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DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG,
KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY,
MA, MD, MG, MK, MN, MU, 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, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, 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, ME, 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).

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