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Crosslinking graphene oxide flakes into nonflammable membrane for safe mass-production

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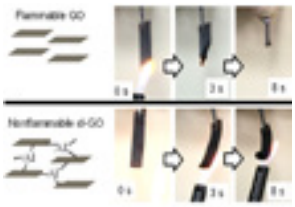
Graphene oxide (GO), a flake-like intermediate for making graphene from graphite, was proven by our lab and others' to possess a fire hazard that can jeopardize the graphene large-scale production and wide applications. To solve this longstanding built-in problem, we have developed a simple, facile and scalable method for polymerizing the irregularly shaped/sized graphene oxide flakes with multivalent metal cations, such as Al3+, into a freestanding, mechanically strong, and paper-like flexible inflammable membrane in the form of a GO-oligomer. Thus-formed membrane that's transparent to the naked eyes, about 10 um in thickness, resists in-air burning on an open flame (at which non-crosslinked graphene oxide was burnt out within ~5 seconds), and resist hydrolysis in water over long time (during which non-crosslinked graphene oxide membrane quickly decomposes). Characterization data from SEM, HRTEM, XRD, microRaman, TGA/DSC, FTIR, and flame tests concluded that the multivalent cations effectively cross-linked the GO flakes, which in turn confirmed a strategy for polymerizing sheet-like nanomaterials in general. With the much improved on-flame and in-water stabilities, the membrane can enable e.g. roll-to-roll printing of high-temperature fuel cell membrane, battery membrane separators and electrodes, wearable electronics, flexible electronics, flexible thin-foil solar-cells, spray-able device packaging, sensors, etc. Other multivalent cations of transition metals and rare earth metals can likewise produce the new polymers with widely tunable electrical, magnetic and optical properties that ordinary graphene cannot possess.



Biography

Z Ryan Tian directs nanosynthesis in both the Chemistry/Biochemistry Department, Institute of Nanoscience/Engineering, and R2R-printing in the High Density Electronics Center at UARK. He develops both new concepts/theories and industry-viable/scalable nanotechnologies e.g., ceramic nanofibers' self-assemblies in nonwoven membrane for energy and medicine, new graphene materials, 3D-printable flexible concrete, etc. His inventions/patents were highlighted on AAAS-Eureka!, Science News, Science Daily, Discovery (News), NBC (TV Channel), Materials Today, ACS, ACerS, MRS, and shown to President Obama (in White House), President of India Dr. Abdul-Kalam (at UARK), Arkansas Governor, Arvest Bank-Owner Jim Walton, Wall Street nanotech-investor Scott Livingston, US iconic entrepreneur Larry Bock, et al. He has co-founded the J Nanotech. Engr. Med, Arkansas Institute of Nanoscience/Engineering, American Society of Nanomedicine, Global Nanomadicine Initiative, and served in numerous nanotech journals' Editorial Boards. He got $45M grants into UARK, published 76 papers, 2 book-chapters, 5 patents (2 provisional), and 186 meeting/invited talks.

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