Research Paper study on graphene and phase changing materials development and investigation status in an architectural field

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Keywords

Interactive, architecture, transformable, responsive, graphene, phase changing, material, innovation, membrane, composite, digital matter, dynamic, production, application.

Abstract

Graphene and phase changing materials after years of improvement and investigation present themselves as new materials for architecture possibly giving new approaches to construction and design techniques. Fabrication and production improvements present them as an alternative to conventional construction materials, drawing graphene most the attention from researchers because its mechanical properties that make it suitable for multiple architecture applications.

Introduction

Actual architecture is improving and changing in technologically, constructions techniques, style, and multiple fields, but there hasn´t been a big change in materials utilization since the mass utilization of concrete.The need for new material approaches that could fit the requirements of the actual responsive, social and ecological architecture has made the researchers look for new materials used in other fields like chemistry and aerospace, that could address the issues and fit these new requirements.*Construction industry being the 24 foremost consumers of material and energy resources has great prospect to developing 25 innovative energy saving and thermally efficient construction materials.(Mohamed, Abeer Samy Yousef. 2017)* Graphene and phase changing materials (PCM) has been proven as two of the most innovative materials of the decade attracting much attention from researchers, physicists, chemists, etc and now architects. Studies are being conducted at many institutes including Massachusetts Institute of Technology and University of Cambridge to understand the structural and mechanical properties of three-dimensional assemblies of graphene. Responsive, transformable architecture is constrained nowadays by the materiality limits as the *Contemporary responsive architecture, in general, is built on the convergence of embedded computation (intelligence) and a physical counterpart (kinetics) that satisfies adaptation within the contextual framework of human and environmental responsiveness.(Fox, M.: 2009)* Needing for new groundbreaking materials that could transform those ideas and digital works into spaces, completing the final labor of the architecture.

Background

A variety of different fields has been studied for the related study, trying to give an open approach to the applications implying architecture both directly or indirectly.Trying to get a future look at the most successful and groundbreaking studies. *Futures might in principle be unpredictable, but in practice, they are more or less discernible(Tonkinwise, Cameron,2015)* Looking on the graphene side one of the most extended problems for applications is the materiality itself, how to build on a human scale with a material that per se is on an atomic scale. The layer materiality of the graphene itself is not redundant for a tridimensional application. *However, there is still a large performance gap between graphene fibers and individual graphene sheets, which mainly results from the fatal defects in the hierarchical structures of graphene fibers.(Fei, B. 2018)* Nevertheless the physical conditions of the material itself can be a real benefit that has to be taken into consideration, possibly it could be one of the strongest points of its layering condition.*Moreover, graphene pos-sesses various outstanding material properties for designing device functions including high optical transmittance, which goes beyond that of conventional transparent conductive materials (>97.7% in the visible color range), for optoelectronic devices; piezo- and thermo-resistive response; and electrical sensitivity for sensing physical parameters and biochemicals.(Hyunmin Kim, Jong-Hyun 2017)* Or even more takin into consideration the application of it not as a standalone material but as a reinforcement of the other technical capabilities of another compound.Acting furthermore as a reinforcement or capabilities assimilation by the receiver material.As we can find it when applied to large composites pieces of carbon fiber resin epoxied.*3D network of graphene branches is found to suppress and deflect the cracks, arresting mechanical failure.(Embrey, Leslie, Pranjal Nautiyal, Archana Loganathan, Adeyinka Idowu, Benjamin Boesl, and Arvind Agarwal. 2017)* Pricing on the production is a big restraint for the large-scale application of graphene, as it makes the cost of even medium size test overwhelming. Nevertheless, the production methods are improving fast and furthermore the application methods of the graphene itself.*low-cost manufacturing method offers a high yield and an excellent potential for developing other applications based on the unique graphene substrate.(Krajewska, Aleksandra, Iwona Pasternak, Grzegorz Sobon, Jaroslaw Sotor, Aleksandra Przewloka, Tymoteusz Ciuk, Jan Sobieski, Justyna Grzonka, Krzysztof M. Abramski, and Wlodek Strupinski. 2017)* Graphene papers, with the advantages of low price, high quality, and simple synthesis processes, have the potential to bridge the gap between nanoscale graphene sheets and real macro-scale applications of graphene *(Zhang, Minwei, Chengyi Hou, Arnab Halder, Hongzhi Wang, and Qijin Chi. 2017)* Phase changing material work in a similar way to materials we know widely as water, but they do in a more intensive and shorter range scale making them useful for multiple applications.*Phase change materials (PCM) take advantage of latent heat that can be stored or released from a material over a narrow temperature range. PCM(Mondal, S. 2008)* Combining these capabilities with the capabilities of layered materials as fabric, where the application of phase changing material has been used *Lately, using 29 microencapsulation technology finely dispersed PCMs are incorporated into other 30 materials to create a large surface area to improve heat transfer.(Wahid, Mazlan Abdul, Seyed Ehsan Hosseini, Hasanen M. Hussen, Hussein J. Akeiber, Safaa N. Saud, and Abdulrahman Th Mohammad. 2017)* Can become an interesting combination of capabilities.

Discussion

With the emphasis on smart assembly, production, combination and purpose-driven specific functionalization for their critical applications the previous studies try to find through deep technical research application to the actual material, taking apart the future improvements that could occur in its field. We could summarize multiple possibilities of utilization of these studies, but we cannot forget about the theoretical approach is given by the utilization of these materials themselves, where does this material is going?and how is going to repercute in the future? Answers that need to respond to extract the maximum capabilities of its materiality and functionality not only on a physical plane but on a theoretical one.

Conclusion

PCM and graphene materials are long-studied material and are still in the growth phase, both in mass application and improvement. There are more studies related to architecture for the phase changing materials, graphene applied studies are more transversal and are related to other fields with possible applications in architecture, letting space for larger improvements in theoretical and physical applications.

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