Self-Heating Graphene Nanocomposite Bricks

RENEWABLE ENERGY, BIOCLIMATIC CONSTRUCTIONS & SUSTAINABILITY CONFERENCE

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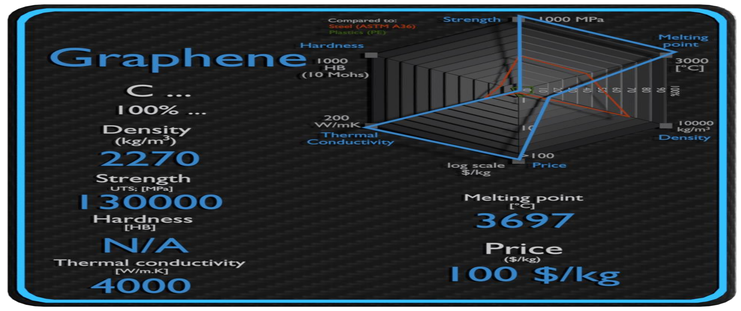
INTRODUCTION

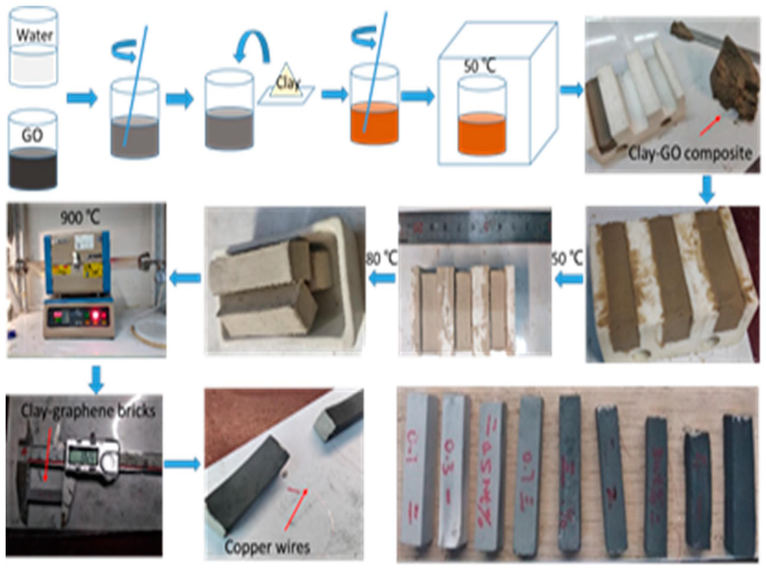
In cold temperature regions, energy used for indoor heating accounts for a significant share of total energy consumption. For both economic and environmental reasons, increasing energy use efficiency is vital. Water pipelines, which are widely utilized for domestic heating, can save energy and money by directly converting electrical energy to thermal energy utilizing joule heating building elements. Pavements, walls, and other stonework have all been built with burnt brick. Graphene nanocomposite bricks with outstanding electrical properties and better mechanical performance were created using the high dispersion quality of graphene oxide (GO) in water, as well as the firing procedure used to generate burned bricks.



APPLICATION

In order to make it practical to use the DC for the voltage source used to power this heating system for the house by keeping it harmful for the residents and efficient, we will be using solar power system connected to an inverter all monitored by a home control panel. The building will be equipped by solar panels that converts the sun energy into a Direct Current, which is sent to the inverter. Besides the bricks will be covered in foam as an insulator to avoid any dangerous accidents.

PREPARATION PROCESS



A high concentration of a GO solution was diluted using de-ionized water, and then stirred manually until it reached a homogeneous state. Then the dried clay powders were weighed and added to the diluted GO solution. Similarly, the mixtures of clay and GO solution (CGOs) were stirred manually to a uniform state without obvious granular substances. After that was done, CGOs were put into the oven with the beaker and dried at 50 °C for 12 h until the mixtures were easy to shape. The CGOs were filled in a custom polytetrafluoroethylene (PTFE) mold and dried for 12h in an oven at the temperature of 50 °C. Brick blanks were then demolded and dried for another 6 hours in an oven at 80 °C, and then sintered for 6 h in a tube furnace in Argon atmosphere at 900 °C (heating rate was 10 °C/min). Finally, the sintered bricks were polished smoothly on all sides to keep regular shape.

PROPERTIES AND RESULTS

1. With the increase in graphene concentration and the electrical conductivity maintained at a stable level, the graphene network became more compacted with more distributed paths for heat generation and transfer, thus sharply enhancing the self-heating properties.

2. X-Ray diffraction analysis on the material proved that graphene can be uniformly distributed across the whole matrix, and covalent bonding was formed between clay and GO. The thermal efficiency can reach up to 88% based on the applied voltage, measured resistance and temperature rise curves.

3. The temperature increase is highly dependent on the graphene concentration under a given applied voltage. Besides, the high concentration of GO is beneficial to the increment of compressive strength and elastic modulus of conductive graphene clay bricks.

CONCLUSION

The graphene nanocomposite bricks can serve as part of a smart building with using series connection method to share voltage to fit different circumstances, which also sheds lights on the development of intelligent buildings through promoting the combination of nanomaterials and building materials.

REFERENCES

Tang, Z., Lu, D., Gong, J., Shi, X. and Zhong, J., 2020. Self-Heating Graphene Nanocomposite Bricks: A Case Study in China. *Materials*, 13(3), p.714.

https://www.mdpi.com/1996-1944/13/3/714/htm

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