Examining the Resolving Power of Starphene Structures and Their Applications in Electronics

1SRIDHAR RAO MATTAPALLY,2NAGANABOINA CHANDRAMOHAN
12Assistant Professor
DEPT of H&S
Vaagdevi College of Engineering, Warangal, TS, India

Abstract:

This study investigates the resolvability of starphene structures, a novel class of two-dimensional materials, and their potential applications in the field of electronics. We analyze the unique properties of starphenes, including their electronic conductivity, stability, and structural integrity, which make them suitable for various electronic applications. By employing advanced characterization techniques, we demonstrate the successful resolution of starphene structures and explore their integration into electronic devices, such as transistors and sensors. Our findings highlight the promising role of starphenes in enhancing electronic performance and pave the way for future advancements in material science and nanotechnology.

1. Introduction

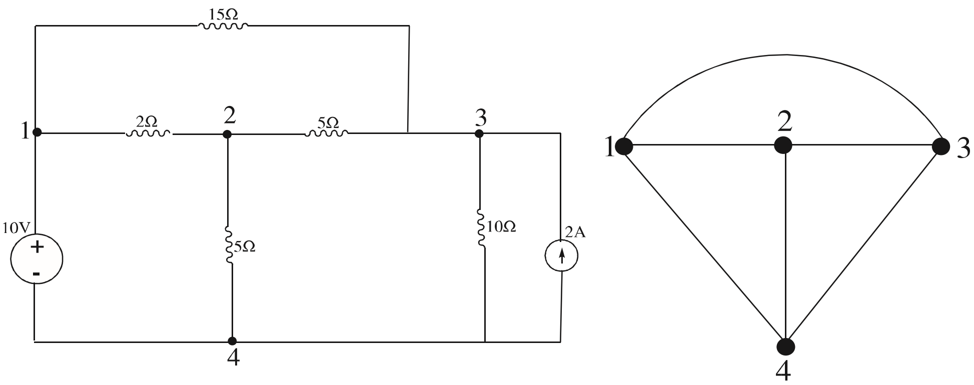
The rapid advancement of nanotechnology and materials science has spurred significant interest in two-dimensional (2D) materials, which possess unique properties that can revolutionize a wide range of electronic applications. Among these materials, starphenes have emerged as a compelling area of study due to their distinctive structural and electronic characteristics. Starphenes are a class of organic compounds characterized by their star-shaped configuration, which enhances electron mobility and offers potential integration into various electronic devices, such as transistors, sensors, and optoelectronics.

The importance of studying starphenes lies in their potential to overcome the limitations of traditional materials used in electronics. As devices continue to shrink in size, the demand for materials that can maintain or improve performance while reducing weight and volume is critical. Starphenes, with their tunable electronic properties and ease of functionalization, present an opportunity to develop next-generation electronic components that are not only efficient but also sustainable.

A key factor in realizing the practical applications of starphenes is understanding their resolvability—the ability to synthesize, characterize, and maintain the structural integrity of these materials. Recent advancements in synthetic techniques, such as bottom-up and top-down approaches, have made it possible to create high-quality starphene structures. Furthermore, advances in characterization methods, including spectroscopy and microscopy, enable researchers to analyze these structures at the molecular level, ensuring that the desired properties are achieved.

In this study, we aim to explore the resolvability of starphene structures through comprehensive synthesis and characterization efforts. By investigating the relationship between structure and electronic properties, we seek to identify the optimal conditions for synthesizing starphenes that exhibit enhanced electrical performance. Additionally, we will examine the incorporation of starphenes into various electronic devices, assessing their functionality and efficiency.

The following sections will detail the methodologies used in the synthesis and resolution of starphene structures, the characterization techniques employed to evaluate their electronic properties, and the potential applications in electronic devices. Through this exploration, we aim to contribute to the growing body of knowledge on 2D materials, highlighting the significance of starphenes in advancing the field of electronics and paving the way for innovative technologies.



and in other areas. The fault-tolerant concept of the definition of resolving set, described by [5], is also a unique approach of examining a graph (structure) wherein fault-tolerant of a solemn main vertex from the resolving set may be allow while the full collection of primary vertices still has a unique location. In 2018, [21] developed the edge metric resolving set, which assigns a unique location to the whole set of branches (edges) instead of main nodes. The authors in [28], investigated the edge version of a fault-tolerant resolving set in 2020. In [22], authors presented the combination version of resolving and edge metric resolving set in 2017, which allows whole sets of main nodes and branches to be uniquely identified. Partition resolving set [6] is created when the whole set of primary vertices, is split down into subgroups and the requirement of acquiring distinct position of the set of principal nodes is met. All of the aforementioned ideas are referred to be metric-based resolvability parameters, and they've been investigated for many circuits, networks and graphs. For more versions of graph theoretical aspects, we refer to see [11,12,41].

Definition 1.3 ([50,25]). "Suppose R Vð Þ@ is the subset of principal nodes set and defined as R ¼ ff1;f2;...;fsg, and let a principal node f 2 Vð Þ@ . The identification rðfjRÞ of a principal node f with respect to R is actually a s-ordered distances ðdðf;f1Þ; dðf;f2Þ;...; dðf;fsÞÞ. If each principal node from Vð Þ@ have unique identification according to the ordered subset R, then this subset renamed as a resolving set of network @. The minimum numbers of the

V St lðð ;m;nÞÞ ¼ fa$_f$;: 1 6f 2ðl þ n 1Þg [fb$_f$;: 1 6f 2ðl þ m 1Þg [fc$_f$;: 1 6f 2ðm þ n 1Þg;

E St lðð ;m;nÞÞ ¼ fa$_f$a$_{fþ1}$;: 1 6f 2ðl þ nÞ 3g [fb$_f$b$_{fþ1}$;: 1 6f 2ðl þ mÞ 3g[fc$_f$c$_{fþ1}$;: 1 6f 2ðm þ nÞ 3g [fa$_f$b$_f$;: 1 6f 21 1; f ¼ oddg[fa$_f$c$_j$;: 21 6f 2ðl þ n 1Þ; f ¼ even; j ¼ 2ðl þ nÞ 1 fg[fb$_f$c$_j$;: 21 6f 2ðl þ m 1Þ; f;j ¼ even; 2n 6 j 2ðm þ n 1Þg:

elements in the subset R is actually the metric dimension of @ and it is denoted by the term dimð Þ@ .”

Results on the resolvability of starphene St lð ;m;nÞ

This section is started by the core of this work, in which the resolving set with cardinality two is chosen from the possible combinations, later it’s generalizations in which the faulttolerant version of resolving set, edge metric dimension and its generalized version which same as the fault-tolerant of given above, mixed metric dimension and at the end final version of all resolvability parameters named as the partition dimension are elaborated.

Lemma 3.1. Let the graph of starphene is St lð ; m; nÞ with l; m; n P 2. Then the cardinality of resolving set of St lð ; m; nÞ is 2.

Proof. Let R ¼ fa1; a2ðlþn1Þg, from the vertex set of graph of starphne St lð ; m; nÞ, with cardinality two. Consider R is one of the potential candidate for the role of resolving set. The identifications of the complete set of nodes in St lð ; m; nÞ with regard to the nodes in R are provided below.

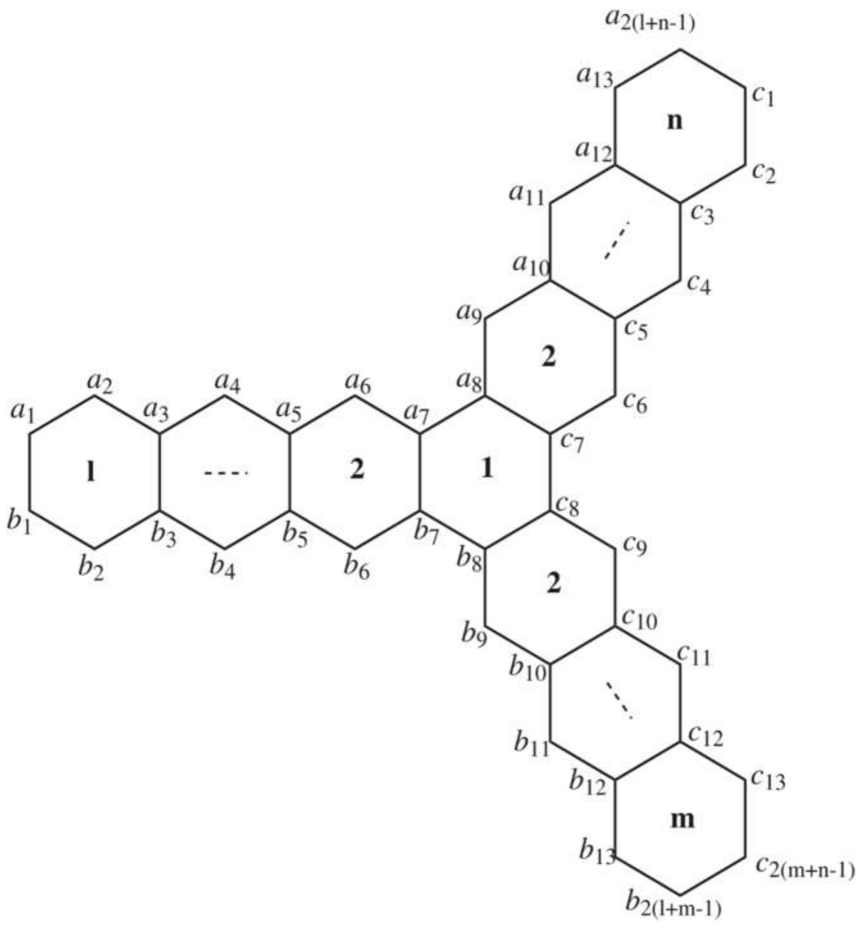


Fig. 2. The labeling of starphene St lð ; m; nÞ.

For f ¼ 1; 2;...; 2ðl þ n 1Þ, the r að fjRÞ, are following; r að fjRÞ ¼ ðf 1; 2ðl þ n 1Þ fÞ:

For f ¼ 1; 2;...; 2ðl þ m 1Þ, the r bð fjRÞ, are following;

r bð fjRÞ ¼ ððff;; 22ððlnþnlÞ þÞ 11 þ ffÞÞ;; ifif ff ¼¼ 211;;22;l...þ ;12;l...;12;ðl þ m 1Þ:

For f ¼ 1; 2;...; 2ðm þ n 1Þ, the r cð fjRÞ, are following;

ð2ðl þ nÞ 1 f; fÞ; if f ¼ 1;2;...;2m 1; Proof. By using the basic technique of double inequality, to prove that the graph of starphene St lð ; m; nÞ has two metric dimension. We refer to see the Lemma 3.1, in that proved we already showed that the potential candidate for the resolving set R ¼ fa1; a2ðlþn1Þg, with 2 cardinality.

Now we will prove that dim St lð ð ; m; nÞÞ P 2. On contrary we can see that the starphene is not a path graph and using Theorem 1.11, it indicated that one metric dimension of St lð ; m; nÞ is not possible. Hence; dim St lð ð ; m; nÞÞ P 2.

Hence,

r c R

Fig. 2. The labeling of starphene St lð ; m; nÞ.

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For f ¼ 1; 2;...; 2ðl þ m 1Þ, the r bð fjRÞ, are following;

r bð fjRÞ ¼ ððff;; 22ððlnþnlÞ þÞ 11 þ ffÞÞ;; ifif ff ¼¼ 21l;;22;l...þ ;12;l...;12;ðl þ m 1Þ:

For f ¼ 1; 2;...; 2ðm þ n 1Þ, the r cð fjRÞ, are following;

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4. Conclusion

The structure of the starphene St lð; m; nÞ is investigated in this article in terms of different resolvability parameters, especially those that rely on the metric of a graph. Before reaching the mixed metric dimension, many generalisations are provided for the first of these factors, which is called the metric dimension. Furthermore, the concept of resolvability parameters is expanded upon by the partition dimension. The findings and conclusions drawn from the study are shown in Table 1.

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