

# Mapping the Research Landscape of Electronic Properties of Graphene: A Citation Network Analysis

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**Abstract:** Graphene has obtained an adorable response from researchers and scientists owing to its meticulous structure and astonishing properties. The rapid evolution of research on the electronic properties of graphene has generated a vast and complex body of literature, necessitating systematic quantitative mapping to understand its intellectual structure and developmental trajectory. In this study, a comprehensive citation analysis of global research on the electronic properties of graphene has been performed. Bibliographic records were retrieved from the Web of Science (WoS) Core Collection covering the period from January 2004 to March 2025. Two specialized bibliometric software tools were employed to construct citation networks, visualize relational structures, and evaluate influential publications, authors, and countries. Sankey plot was generated to visualize the relationships among key authors, cited references, and keywords, thereby providing an initial structural overview of the dataset. Direct citation analysis is employed to trace the chronological knowledge flow and identify seminal contributions shaping the field. Network centrality indicators and clustering metrics are applied to identify influential authors, countries, and core publications. Various bibliometric indicators like number of documents, total linking strength, number of citations and normalized citations have been used in the analysis, as they reflect different aspects of contribution. Normalised citations have been evaluated from the Vosviewer map file by writing a Python script. Bibliographic coupling is used to detect contemporary research clusters and emerging thematic frontiers, while co-citation analysis reveals the foundational intellectual base and conceptual interconnections within the domain. By integrating three complementary citation methods, this study provides a structured overview of the knowledge architecture governing research on the electronic properties of graphene. The findings serve as a reference framework for researchers seeking to understand both the maturity and emerging opportunities within this rapidly advancing field.

**Keywords:** Direct citation analysis, bibliographic coupling, co-citation analysis, normalized citations, VOS-viewer, Bibliometric R package

