*Article*

**Title of the article**

https://orcid.org/0000-0000-0000-0000Name Surname1, https://orcid.org/0000-0000-0000-0000Name Surname1,2, https://orcid.org/0000-0000-0000-0000Name Surname1,\*, etc.

1Affiliatiated Department, Institution, City, Country

2Affiliatated Department, Institution, City, Country

\*Correspondence: [mail@mail.mail](mailto:mail@mail.mail)

1) The abstract should be brief (100-300 words) and provide a standalone summary including the research objective, methods, key findings, and conclusions. It should avoid repetitions of the main text, symbols, equations, citations, figures and tables, web links, and emails.

**Example:**

**Abstract.** In this study, the effect of nanostructuring and crystal defects on the phonon spectra and thermal conductivity of silicon in the wavelength range from 2 to 20 μm is investigated. Numerical methods including density-functional theoretical modeling with a calculation step of 0.01 nm and molecular dynamics with a time step of 0.5 fs were used to achieve the goal, which allowed us to trace the microscopic mechanisms of phonon scattering with high accuracy. The experimental part was carried out using infrared spectroscopy, which provided resolution down to 0.1 μm, allowing detailed characterization of the change in the phonon spectral distribution. Modeling revealed that the introduction of controlled defects leads to an increase in phonon scattering and a 25-35% decrease in thermal conductivity compared to samples without nanostructural changes. The obtained results indicate the possibility of effective control of thermal properties of materials by optimizing their nanostructure, which opens prospects for the development of highly efficient thermoelectric systems and improving the thermal regime in modern semiconductor devices.

**Keywords:** 5-10 comma-separated words or phrases.

**1. Introduction**

2) The Introduction should provide a structured and logical flow, ensuring accessibility for readers, including non-specialists. It must begin with a general introduction to the topic, followed by a discussion of the current state of research and existing issues. Then, a literature review should be conducted, critically analyzing recent **original research articles (not reviews)** that attempted to solve the identified problems. The introduction should then define the **research gap**, formulate a **hypothesis**, and conclude with a **clear goal statement**.

a) The opening sentences of the Introduction should introduce the research topic and key terms to ensure clarity for a broad audience. Authors should explain why the topic is important, define essential concepts, and highlight the fundamental principles behind the study.

**Example:**

Nanostructured silicon has significant potential for thermal conductivity control in thermoelectric and semiconductor devices [1]. However, the use of conventional processing methods often leads to defects that degrade its thermal and electrical properties [2]. The problem remains the need to find optimal conditions for balanced phonon scattering and preserving the structural integrity of the material [3]. The discrepancy between theoretical models and experimental data complicates the reliable development of methods for controlling the thermal characteristics of nanostructured silicon [4].

b) After introducing the topic, the authors must explain the current situation in the research field and identify existing issues.

**Example:**

Nanostructured silicon, despite its advantages, faces the difficulty of achieving optimal thermal conductive properties with controlled introduction of defects into the structure [5]. The use of nanoparticles and defects in silicon can improve phonon scattering, but their effect on thermal performance depends on the concentration and size of the additives [6]. Excessive introduction of defects can lead to deterioration of the mechanical properties of the material, which precludes its use in highly loaded devices [7]. Therefore, research continues to develop methods to find a balance between improving phonon scattering and preserving the functional properties of silicon [8].

c) The next section of the Introduction must include a **literature review**, focusing on recent **original studies** that attempted to solve these issues. The literature should be carefully selected to ensure relevance to the current study.

**Example:**

[9] investigated nanostructured silicon with controlled defect introduction and doping, which reduced the thermal conductivity to 1.2 W/(m-K) after heat treatment. However, the thermal conductivity value remained above 2.0 W/(m-K) in the early stages of processing, which limits the application of the material in fast heat sink systems. Another study [10] presented silicon with the addition of nanofilaments, which improved phonon scattering and mechanical stability, but resulted in excessive charge carrier scattering and reduced electron mobility. [11] studied the use of surface passivation techniques, demonstrating improved control over phonon distribution, but observed a delayed decrease in thermal conductivity during the initial stages of treatment. Despite the progress made, no study has been able to simultaneously achieve rapid thermal conductivity reduction and maintain high electronic performance.

d) Following the literature review, authors must **state the problem** that remains unresolved, based on the limitations of previous studies.

**Example:**

Most studies on nanostructured silicon focus on either reducing thermal conductivity or improving electron mobility, but very few papers offer a balanced approach to simultaneously achieve rapid changes in thermal performance while maintaining high electronic properties. This creates a need to develop techniques that provide both rapid thermal conductivity modification and stable electronic mobility.

e) Based on this problem statement, authors should **formulate a hypothesis** that will be tested in the study. A hypothesis is a reasoned assumption that explains how the existing research gap could be addressed.

**Example:**

It can be assumed that the use of controlled doses of alloying elements and surface modification methods will allow to achieve an optimal balance between rapid reduction of thermal conductivity at early stages of processing and preservation of stable electronic characteristics of nanostructured silicon.

f) Finally, the **goal statement** should clearly define the study’s objectives and highlight its novelty.

**Example:**

The aim of this study is to develop nanostructured silicon with thermal conductivity not exceeding 1.2 W/(m-K) in the first 5 days of processing and maintaining electron mobility of at least 500 cm²/(V-s). Through process optimization using numerical methods such as density-functional modeling and molecular dynamics, as well as through experimental measurements, the study aims at fine-tuning the phonon scattering. This integrated approach allows simultaneous control of thermal and electronic characteristics, minimizing the negative influence of structural defects. As a result, the developed technique aims to bridge the existing gap between theoretical models and experimental data, which has not been previously achieved.

**2. Methods**

3) The Methods section should provide a **clear and sequential** description of the actions performed in the study, ensuring that the research can be **replicated**. Authors must specify the **resources used**, including methodologies, techniques, materials and their properties, equipment and their parameters, and software. **Each mention of an existing methodology or resource should be supported by citations rather than redundant explanations.** Additionally, the Methods section must avoid presenting results and instead focus only on the procedures undertaken. Authors are encouraged to **perform statistical analysis** and specify the methods or equations used. The clarity of procedure descriptions is more important than volume, so the section should be as concise as possible while maintaining completeness.

a) The **sequence of procedures** should be presented logically to ensure replicability. Authors should begin by describing the **materials** used, followed by the **experimental procedures**, including sample preparation, testing methods, and analysis techniques.

**Example:**

Nanostructured silicon was prepared using high-purity monocrystalline silicon doped with boron and phosphorus, as well as with the introduction of nanoparticles, the proportions of which were chosen on the basis of previous studies [11]. The properties of the starting materials were determined according to the technical data sheets of the suppliers [12], and no changes were made in their composition.

b) Next, authors must **describe the experimental setup** in detail, including equipment and parameters, citing sources where applicable.

**Example:**

The properties of nanostructured silicon were evaluated by infrared spectroscopy to record phonon spectra in the wavelength range from 2 to 20 μm using standardized equipment [13]. The spectral data obtained allowed the determination of changes in phonon scattering characteristics for each series of samples [14]. Thermal conductivity was measured by laser pulse analysis using an LA-500 instrument having a power of 100 W and a measurement accuracy of ±0.05 W/(m-K) [15]. Electronic properties, including charge carrier mobility, were determined by the Hall method in accordance with established standards [16].

c) **Any software used for data processing** should be explicitly mentioned. If statistical analysis was conducted, authors must specify the methods and equations used.

**Example:**

Statistical analysis was performed using MATLAB R2020a [18], applying one-factor analysis of variance (ANOVA) [19] to assess the significance of differences in thermal conductivity and electron mobility between samples. The coefficient of variation (CV) was calculated for each data set to assess the consistency of the results.

d) The **Methods** section **should not include results**. For example, if the chemical composition of materials was determined through laboratory testing, authors should **only state that such tests were performed**.

**Example:**

The oxide composition of silicon and alloying additives was analyzed using X-ray fluorescence analysis (XRF, Malvern Panalytical Axios MAX) according to [19] and the results are presented in the Results section.

e) If material properties were obtained from other studies, authors should cite the source instead of restating values.

f) Finally, the length of the Methods section should reflect the complexity of the study. If a short but complete description allows for full **reproducibility, conciseness is preferred**. The focus should be on **clear, structured descriptions of procedures rather than unnecessary elaboration**.

**3. Results and Discussion**

4) The Results and Discussion section should present findings **in the same order as stated in the Methods section** to ensure logical flow. Authors should prioritize **tables and illustrations (figures, infographics, or graphs)** over plain text to improve clarity and accessibility. **Each result** must first be introduced in text form, followed by its corresponding table or figure, and then **described in detail**. After describing each result, authors should **identify trends and patterns** before engaging in a **discussion** that **compares** their **findings** with previously published research **from the literature review in the Introduction**.

a) Each result must begin with an introductory sentence that cites the relevant table or figure. Following this statement, the table or figure should be placed in the manuscript.

**Example:**

The results of thermal conductivity and electron mobility of the nanostructured silicon are summarized in Table 1.

Table 1 – Example of a table

|  |  |  |
| --- | --- | --- |
| Mix ID | Slump flow, mm | Flow time, s |
| NS-1 | 1.15 ± 0.03 | 520 ± 20 |
| NS-2 | 1.25 ± 0.04 | 480 ± 25 |
| NS-3 | 1.20 ± 0.02 | 500 ± 15 |

b) After presenting the table or figure, authors must **describe the data in detail**, ensuring that readers who prefer text-based explanations can fully understand the results.

**Example:**

The thermal conductivity of the nanostructured silicon ranged from 1.15 W/(m-K) to 1.25 W/(m-K), indicating sufficient heat transfer efficiency. The lowest value of thermal conductivity, 1.15 W/(m-K), was recorded for sample NS-1, while material NS-2 showed the highest value of 1.25 W/(m-K). The electron mobility of the materials ranged from 480 to 520 cm²/(V-s), confirming good conductivity with minimal variation between samples.

c) After descriptions, authors should **identify trends and patterns** emerging from results.

**Example:**

A clear trend was observed: as the water-cement ratio decreased, the slip flow decreased and the V-funnel transit time decreased. This indicates that the decrease in water content led to an increase in the viscosity of the mixtures, which improved their cohesiveness.

d) Next, authors must **discuss the findings, comparing them with** previous studies **cited in the literature review of the Introduction**. The discussion should **highlight similarities, differences, and possible explanations** for any deviations.

**Example:**

The observed thermal conductivity values are in agreement with the data of [11], where samples treated in similar regimes showed comparable values. However, the electron mobility in this study was slightly lower than in [9], which may be due to differences in doping and surface treatment methods. Despite the satisfactory thermal conductivity reduction results, the data obtained indicate a trade-off between thermal and electronic performance, which is consistent with the findings of previous studies [10].

e) **Each procedure** mentioned in the Methods section **must have** corresponding **results**, ensuring completeness and consistency. If compressive strength tests were performed, results should follow the same structured approach.

**Example for the next result:**

The results of thermal conductivity and electron mobility are shown in Figure 1.

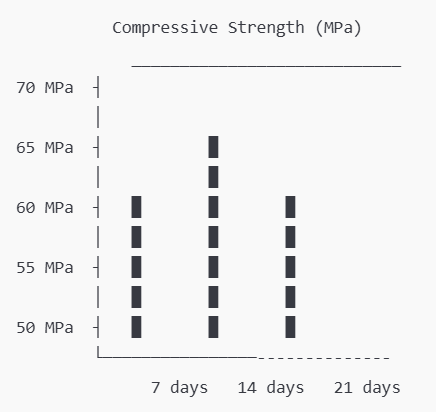


Figure 1 – Compressive Strength Results

Figure 1 presents the results of compressive strength measurements for different specimens at different stages (7, 14, 21 days). As can be seen from the graph, the specimens reach a strength of about 55 MPa on day 7, about 60 MPa on day 14 and about 65 MPa on day 21. This increase in strength indicates a stable development of the mechanical properties of the material over time. The data show a positive trend of compressive strength increase, which confirms the suitability of the material for long-term structural applications.

**4. Conclusions**

5) The Conclusion must be **concise and to the point**, summarizing key findings **with numerical values**, stating **observed patterns**, and highlighting the study’s contributions. No new data or references should be introduced. The enumerated conclusions are preferred.

a) Authors should briefly state the main results, avoiding unnecessary repetition.

**Example:**

1. In this study, nanostructured silicon samples have been developed that exhibit thermal conductivities of 1.15-1.20 W/(m-K) on day 7 of heat treatment and reach 1.2 W/(m-K) on day 21, while providing electron mobility in the range of 480-520 cm²/(V-s).

b) Any major tendencies found in the study should be clearly mentioned.

**Example:**

2. It was found that decreasing the annealing temperature increased the early electronic mobility but increased the initial thermal conductivity. Additionally, increasing the alloying element content reduced the stabilization of thermal conductivity, but improved the long-term electronic performance of the material.

c)Authors should explicitly state whether the study addressed the research problem.

**Example:**

3. The proposed methodology for processing nanostructured silicon successfully combines the reduction of thermal conductivity with the preservation of stable electronic characteristics, overcoming the trade-off between these parameters identified in previous studies.

d) If applicable, briefly mention how the findings can be used.

**Example:**

4. The nanostructured silicon samples, due to the rapid achievement of specified thermal conductivity and electron mobility parameters, are suitable for applications in rapid start-up of high-performance devices, which accelerates the technological cycle of development and implementation of new systems.

e) Mention constraints and possible further studies.

**Example:**

5. Considering the results, further research is needed to better understand the long-term stability and durability of nanostructured silicon under real-world operating conditions and different temperature regimes.

**Acknowledgments**

This section is optional and may provide (exclude if not applicable). In this section, the authors may indicate funding sources and grants, agencies, or individuals that supported the current study. When doing so, the authors are requested to carefully check the grant number, and (or) order of funding sources.

**References**

6) All the references should adhere to the journal’s formatting style. Excessive self-citation is discouraged unless directly relevant. Authors are encouraged to use software like Mendeley for consistency and error-free formatting.

a) Each reference should be recognizable and findable.

b) Every reference listed must be cited in the text, and vice versa.

c) Each reference must include all necessary details (authors, title, journal/conference name, volume, issue, pages, year, DOI if available).

d) The references should be presented in Latin letters and adjusted to the IEEE style.

e) The Cyrillic references should be transliterated; the [transliteration tool](https://www.itranslit.com/) can be used.

**Example:**

[1] M. Hase, D. Tanisawa, O. Norimasa, R. Kamemura, Sh. Miyake, M. Takashiri, “Experimental study on the effect of impurity concentration on phonon and electronic transport properties of single-crystal silicon,” *Results in Physics*, vol. 47, p. 106356, 2023, doi: 10.1016/j.rinp.2023.106356

[2] R. Cingi, B. Balapanov, M. Uysal, B. F. Aygun, S. Montayev, and O. Canpolat, “A Review of Strategies for Developing Promising Thermoelectric Materials by Controlling Thermal Conduction,” *Physica Status Solidi (A) Applications and Materials Science*, vol. 216, no. 14, p. 1800904, 2019, doi: 10.1002/pssa.201800904

[3] N. Tandon, J.D. Albrecht, L.R. Ram-Mohan, “Electron-phonon interaction and scattering in Si and Ge: Implications for phonon engineering,” *Journal of Applied Physics*, vol. 118, no. 4, p. 045713, 2015, doi: 10.1063/1.4927530

**Information about authors:**

*Name Surname* – Degree, Title, Position, Department, Institution, City, Country, [mail@mail.mail](mailto:mail@mail.mail)

**Author Contributions:**

*Name Surname* – concept, methodology, resources, data collection, testing, modeling, analysis, visualization, interpretation, drafting, editing, funding acquisition.

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*Received:* (specified by journal Editor)

*Revised:* (specified by journal Editor)

*Accepted:* (specified by journal Editor)

*Published:* (specified by journal Editor)

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- Adjust the manuscript to the template, do not change its format and style

- Submit manuscripts in *.doc* or *.docx* format, max 20 Mb

- Use Times New Roman, single-spaced, with 2 cm margins, portrait orientation

- Align the main text by width with a 1.25 cm offset

- Make Sections bold and align them in the center with empty lines of 14pt and 12pt before and after

- Make Sub-sections italic and alight them to the left edge with an empty line of 12 pt before

- Figures and Tables must appear centered with no offset after their first mention in the text being cited as (Figure 1) or Figure 1, and not extending beyond page margins

- Captions for figures and tables must be standalone, descriptive, and centered; figure captions go below, and table captions above

- Multiple figures can be placed in one line and cited together (e.g., Figure 2 or Figures 3 and 4)

- For multiple figures in a row, use an invisible table for alignment and center captions appropriately

- Use hyphens and commas when citing multiple figures or tables (e.g., Figures 6-8 or Figures 6, 7, 8-9)

- Use at least 1 figure or table and provide their detailed description (trends)

- Exclude vertical lines in tables

- Use a standard equation editor for the equations, number them as (1) and cite them as Eq. (1) or Eq. (1-3) for multiple

- Do not use Cyrillic letters

- Ensure good English using [Grammarly](https://www.grammarly.com/)

- Use proper citations, preferably recent references indexed in Scopus and Web of Science

- Adjust citations and References to [IEEE style](https://journals.ieeeauthorcenter.ieee.org/wp-content/uploads/sites/7/IEEE_Reference_Guide.pdf) using [Mendeley](https://www.mendeley.com/)

- Use an online [transliteration tool](https://www.itranslit.com/) for Cyrillic references

- The list of references should be 10pt in size and aligned by width

- Ensure the correct authors’ [ORCID](https://orcid.org/), name, degree, title, position, affiliation, and email

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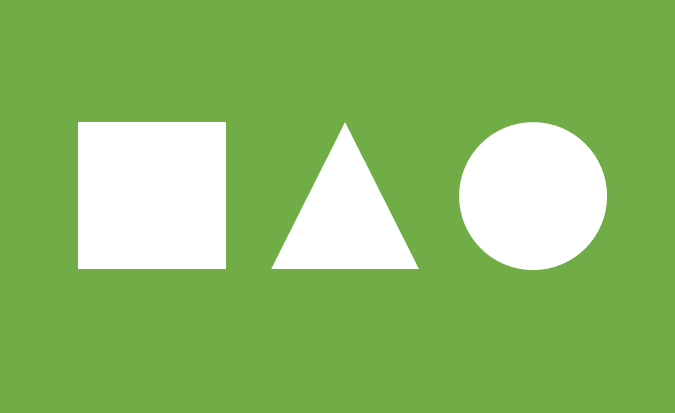


Figure 1 – Example of a single figure

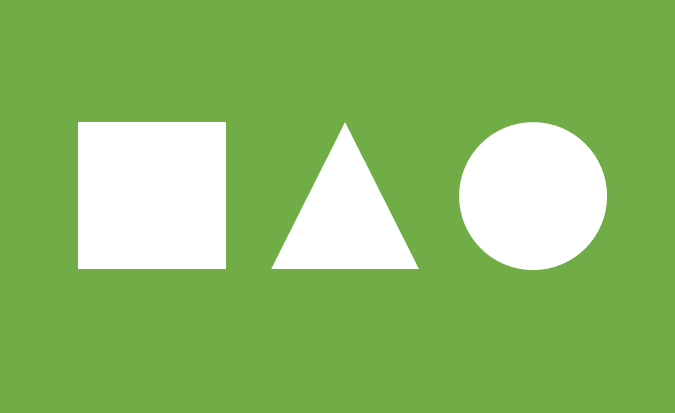
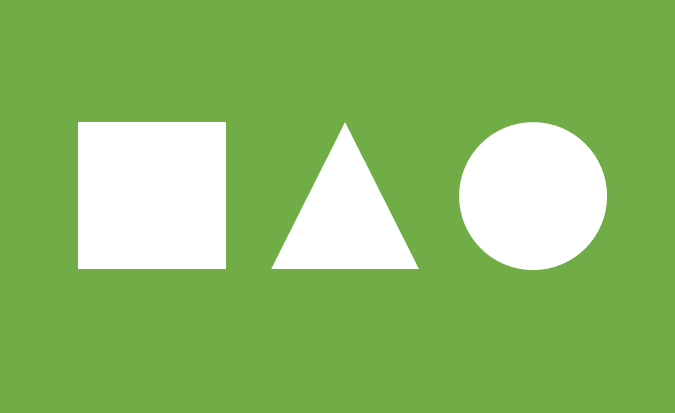
 

Figure 2 – Example of a single figure

|  |  |
| --- | --- |
|  |  |
| Figure 3 – Example of several figures in a line | Figure 4 – Example of several figures in a line |

|  |  |
| --- | --- |
|  |  |
| a) Name of Figure 5a | b) Name of Figure 5b |
| Figure 5 – Example of several figures in a line with a joint name | |

Table 1 – Example of a table

|  |  |  |  |
| --- | --- | --- | --- |
| Column 1 | Column 2 | Column 3 | Column 4 |
| Row 1 |  |  |  |
| Row 2 |  |  |  |
| Row 3 |  |  |  |

(1)

Where: *n* – number; *k* – coefficient; etc.