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Bismuth chalcogenides inside single-walled carbon nanotubes

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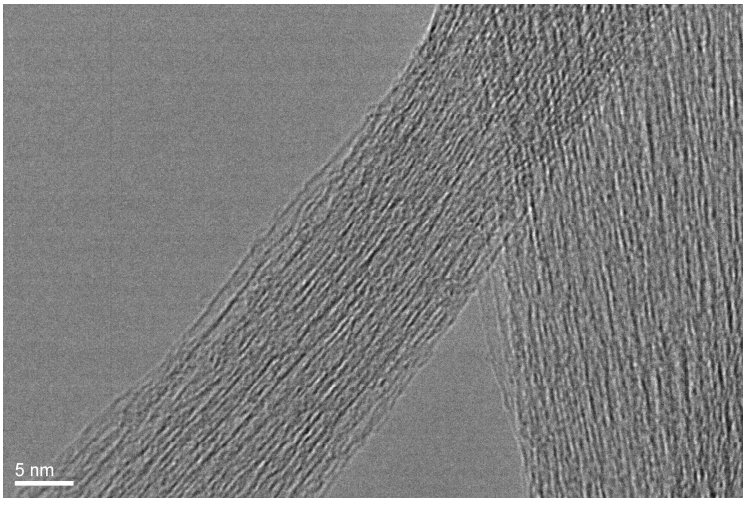
INTRODUCTION & AIM

Single-walled carbon nanotubes (SWCNTs) attract attention of researchers, because of the unique physical properties. The SWCNTs are filled with different substances to realize the application potential. Bismuth chalcogenides are topological insulators with unique crystal structures. They exhibit new phases in the interiors of carbon nanotubes. One-dimensional phases provide new physical properties. These can be applied in machines and other applications. The electronic properties of bismuth chalcogenides have attracted the attention of researchers. Spectroscopy is applied to investigate alterations in the band structures and the electronic structures of filled carbon nanotubes [1, 2].

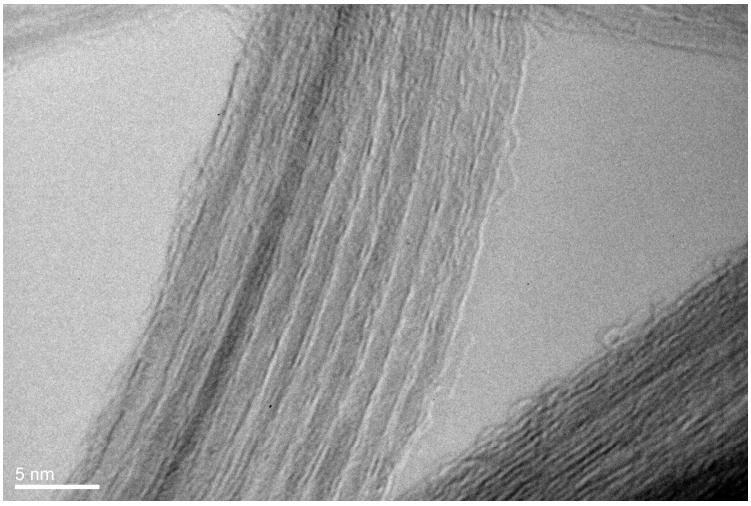
METHOD

Here, we investigate the electronic properties of bismuth chalcogenide-filled single-walled carbon nanotubes. Transmission electron microscopy shows the filling of SWCNTs with atomic nanowires. The loaded substances are detected inside the SWCNTs. Atoms of bismuth chalcogenides are found within the SWCNT walls. Energy dispersive X-ray analysis proves the chemical composition and the stoichiometry of the compounds inside the SWCNTs. Raman spectroscopy shows slight modifications of Raman modes. These include slight shifts of peaks and alterations in peak profiles.

RESULTS & DISCUSSION



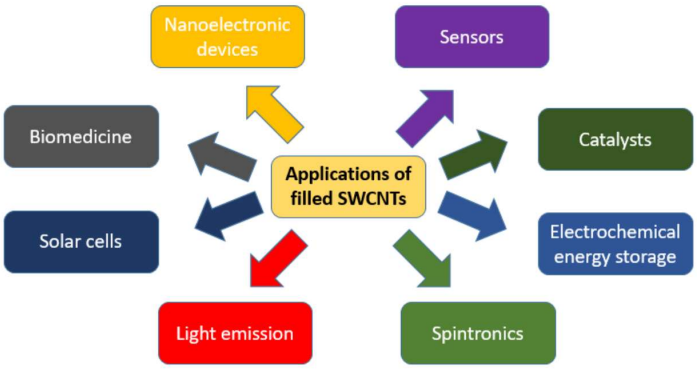
The HRTEM data of bismuth selenide-filled SWCNTs.



The HRTEM data of bismuth telluride-filled SWCNTs.

CONCLUSION

The applications in machines require information on the modified electronic properties of the filled SWCNTs. This work opens new avenues for the novel applications of carbon nanotubes. Automation and control systems need new materials with the researched band structure. The physics of this system brings new phenomena. The effects on the electronic structures investigated in this work are useful in other applications, too.



The applications of filled SWCNTs [3]. Copyright 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

FUTURE WORK / REFERENCES

1. Kharlamova, M.V. et al. Nanomaterials 2022, 12, 42.
2. Kharlamova, M.V. et al. Nanomaterials 2023, 13, 180.
3. Kharlamova, M.V. et al. Nanomaterials 2023, 13, 314.