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Terbium iodide-filled single-walled carbon nanotubes: microscopy and spectroscopy investigations

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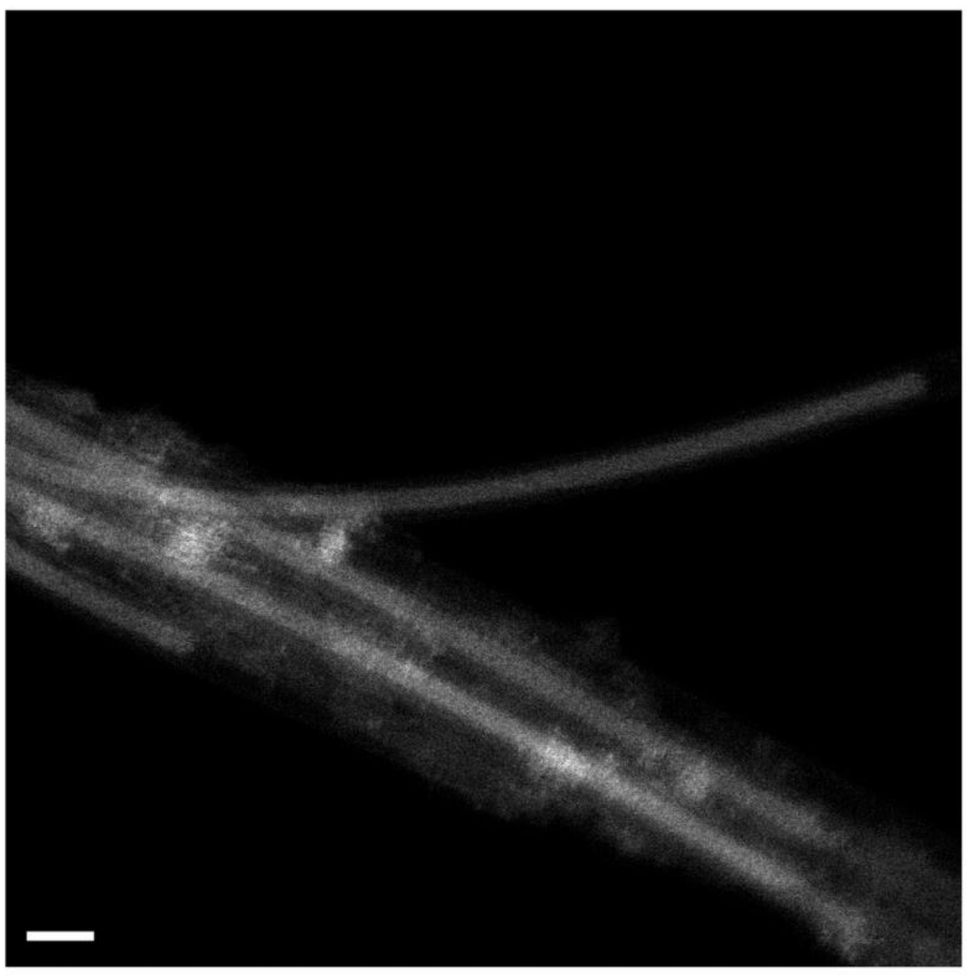
INTRODUCTION & AIM

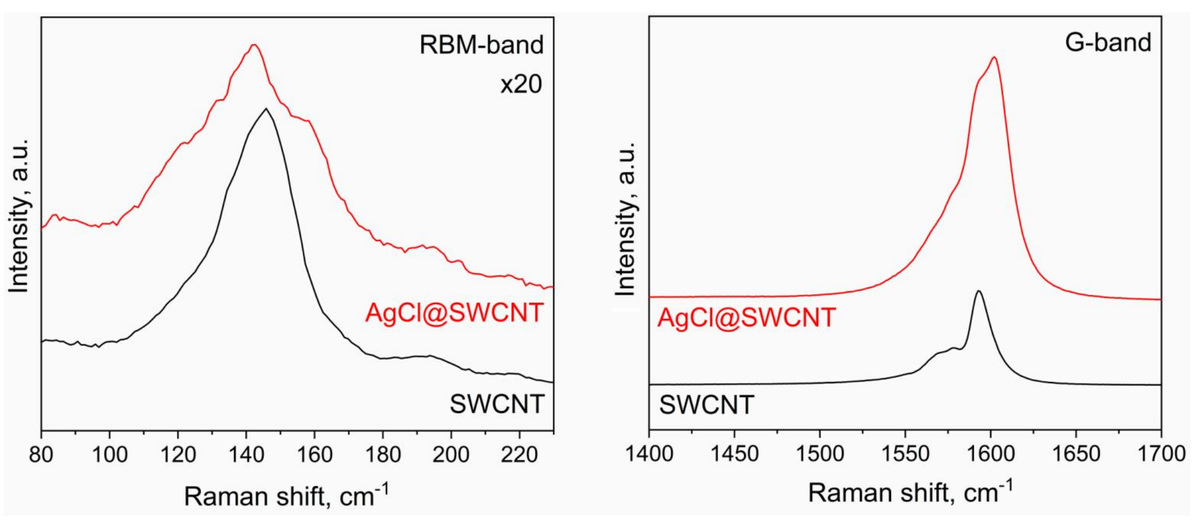
Terbium (III) iodide is an interesting chemical compound with unique chemical properties [1]. The introduction of terbium iodide into single-walled carbon nanotubes (SWCNTs) is an environment-friendly process, and it leads to the development of new nanocomposites with improved properties. The embedded terbium iodide forms new one-dimensional atomic structures inside the SWCNTs. Moreover, the electronic properties of filled SWCNTs are modified.

METHOD

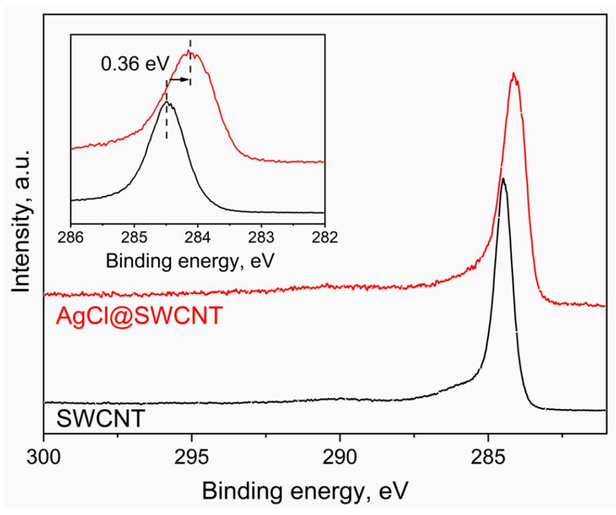
Here, the atomic structures of terbium iodide-filled SWCNTs are investigated using scanning transmission electron microscopy (STEM), and their microstructure, morphology, and filling degrees are studied. The electronic properties of filled SWCNTs are investigated using spectroscopy. Raman spectroscopy provides information on the charge transfer inside filled SWCNTs. These data on charge transfer are required for the application of terbium iodide-filled SWCNTs in nanoelectronics, and sensors.



The STEM image of the silver chloride-filled SWCNTs [2]. 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.



The Raman spectra of the silver chloride-filled SWCNTs [2]. 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.



The C 1s X-ray photoelectron spectroscopy data of the silver chloride-filled SWCNTs [2]. 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.

CONCLUSION

The data show a strong p-doping of SWCNTs with the charge transfer from SWCNTs to terbium iodide. The data from Raman spectroscopy testify to the shift of the Fermi level to the valence band of the SWCNTs. It is comparable to the data for SWCNTs filled with other rare earth metals using environment-friendly processes.

FUTURE WORK / REFERENCES

[1] Kharlamova M. V. et al. Raman spectroscopy study of the doping effect of the encapsulated terbium halogenides on single-walled carbon nanotubes. Applied Physics A. 2017, 123(4), 239.
[2] Kharlamova M.V. Photoemission Insight to Filling of Large 1.7 nm Diameter Single-Walled Carbon Nanotubes with Silver Chloride. Eng. Proc. 2023, 37, 46.