

# Synthesis and structural characterization of monomers and polymers of silver(I) complexes

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## Introduction

Rapidly increasing phenomenon of drug resistance, the search for new and effective antimicrobial agents are a worldwide concern. Silver metal and salts known to possess desirable antibacterial, antifungal, antiviral and antiproliferative properties<sup>1-3</sup>, these features provide a versatile platform for drug design that is now being exploited in several areas. Silver nitrate has been extensively used for the prevention of neonatal conjunctivitis since seventeenth century till today<sup>4</sup>. Silver compounds are also well known for their antimicrobial properties and are widely used in the treatment of wounds and burn infections such as silver sulfadiazine (SSD or Ag-SDZ) is the most popular silver drug used in wound therapy and medicinal devices. As an addition, silver compounds used for treating mental illness, epilepsy and nicotine addiction<sup>5</sup>. In view of these observations and in continuation of our current interest in the synthesis and characterization of four complexes of silver(I) dithiocarbamate containing bisphosphine ligands.

## Aims and Objectives

- Main aim of the research project is to design the new dithiocarbamate silver(I) with bisphosphine complexes which would potentially lead to the development of new antimicrobial agents and the treatment of a variety of microbial diseases effectively.
- The goal of the research work has been planned to synthesize a series of Ag(I) complexes with mixed ligands like bisphosphine (dppm,dppe,dppp,dppb) dithiocarbamate (DMDT and DEDT).
- Characterization of synthesized complexes by elemental analysis, FTIR, <sup>1</sup>HNMR, <sup>13</sup>CNMR and single crystal X-ray diffraction.

## References

<sup>1</sup> Varna, D., Zainuddin, D. I., Hatzidimitriou, A. G., Psomas, G., Pantazaki, A., & Papi, E. (2019). Homoleptic and heteroleptic silver (I) complexes bearing diposphane and thioamide ligands: Synthesis, structures, DNA interactions and antibacterial activity studies. *Materials Science and Engineering: C*, 99, 450-459.

<sup>2</sup> Achar, G., Uppendranath, K., Ramya, V., Biffis, A., Keri, R. S., & Budagumpi, S. (2017). Synthesis, characterization, crystal structure and biological studies of silver(I) complexes derived from coumarin-tethered N-heterocyclic carbene ligands. *Polyhedron*, 123, 470-479.

<sup>3</sup> Leitao, J., Sousa, S., Leite, S., & Carvalho, M. (2018). Silver Camphor Imine Complexes: Novel Antibacterial Compounds from Old Medicines. *Antibiotics*, 7(3), 65.

<sup>4</sup> Altaf, M., Stoeckli-evans, H., Cuin, A., Nakamura, D., Rogério, F., Queico, C., Ben, T. (2013). Synthesis, crystal structures, antimicrobial, antifungal and antituberculosis activities of mixed ligand silver(I) complexes. *Polyhedron*, 62, 138–147.

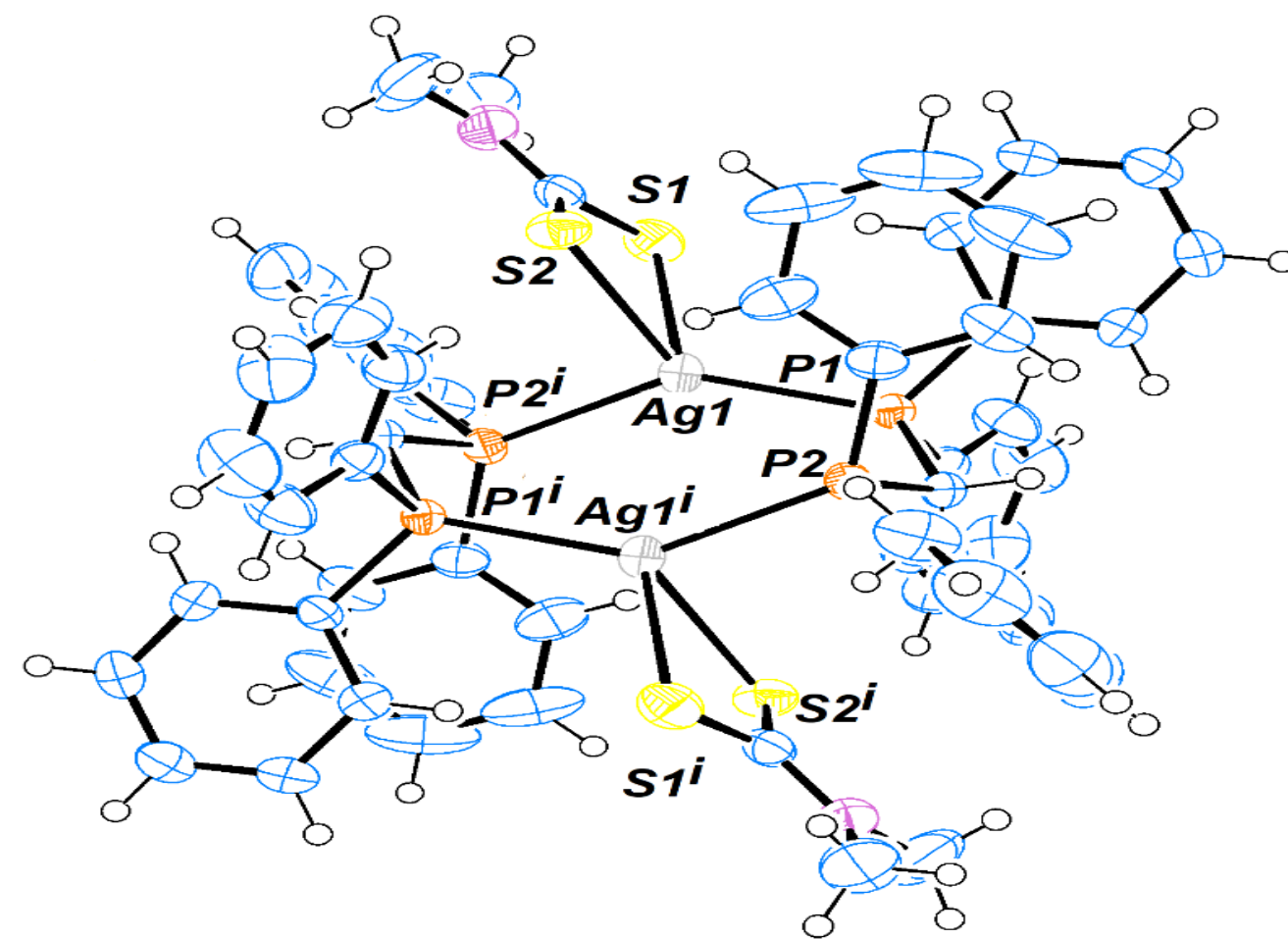
<sup>5</sup> Liang, X.; Luan, S.; Yin, Z.; He, M.; He, C.; Yin, L.; Zou, Y.; Yuan, Y.; Li, L.; Song, X.; Lv, C.; Zhang, W., (2018) Recent advances in the medical use of silver complex. *European Journal of Medicinal Chemistry*, 157, 62-80.

## Results

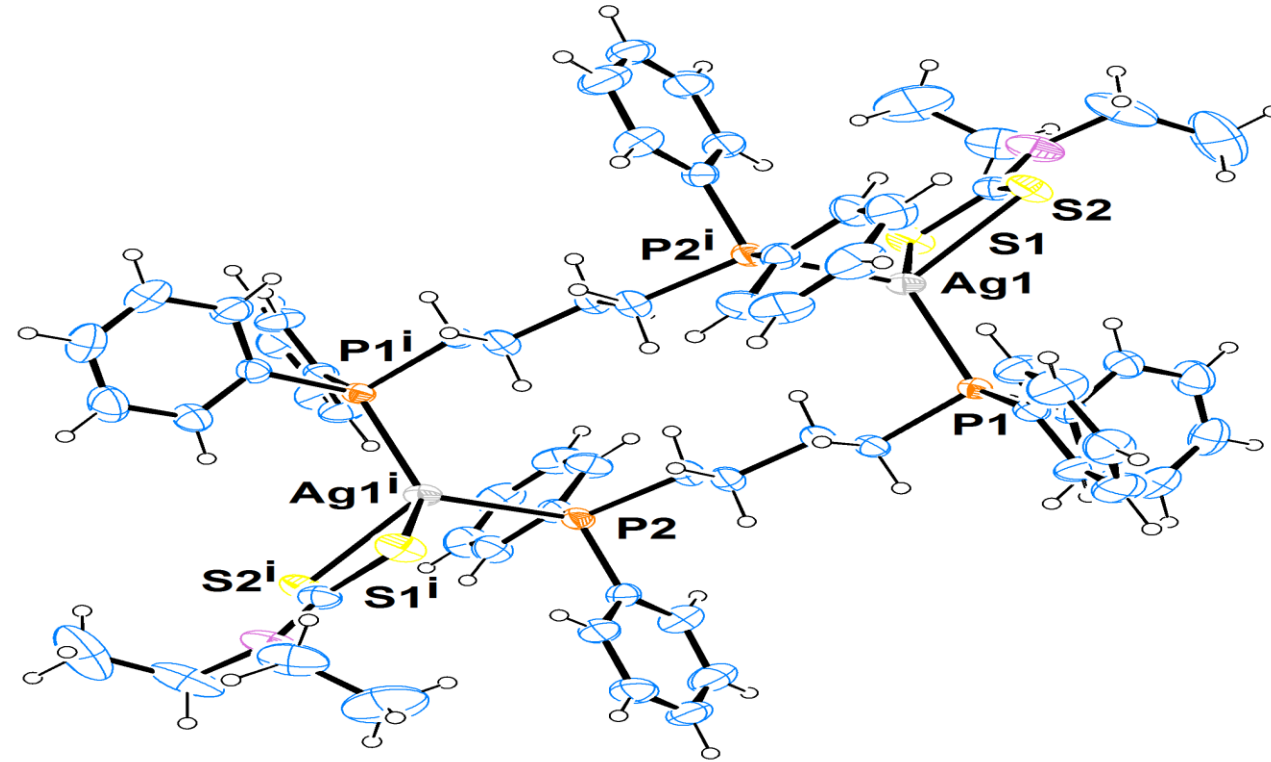
### Elemental analysis results

| Complexes                                                                                                                                | Found (Calc.) (%) |             |             |              | M. P (°C ) |
|------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------|-------------|--------------|------------|
|                                                                                                                                          | C                 | H           | N           | S            |            |
| [Ag <sub>2</sub> (dppm) <sub>2</sub> (S <sub>2</sub> CN(CH <sub>3</sub> ) <sub>2</sub> ) <sub>2</sub> ]. C <sub>2</sub> H <sub>3</sub> N | 55.33(55.13)      | 4.81 (4.78) | 4.31 (4.29) | 9.39 (9.79)  | 141        |
| [Ag(dppe)(S <sub>2</sub> CN(CH <sub>3</sub> ) <sub>2</sub> ) <sub>n</sub>                                                                | 55.64(55.59)      | 5.20 (4.83) | 2.22 (2.24) | 8.89(10.2 3) | 283        |
| [Ag(dppp)(S <sub>2</sub> CN(CH <sub>3</sub> ) <sub>2</sub> ) <sub>n</sub>                                                                | 57.13(56.25)      | 5.47 (5.04) | 2.62 (2.19) | 11.80 (9.99) | 212        |
| [Ag <sub>2</sub> (dppb) <sub>2</sub> (S <sub>2</sub> CN(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> ) <sub>2</sub>                      | 58.97(58.06)      | 6.12 (5.61) | 2.89 (2.05) | 11.49 (9.38) | 183        |

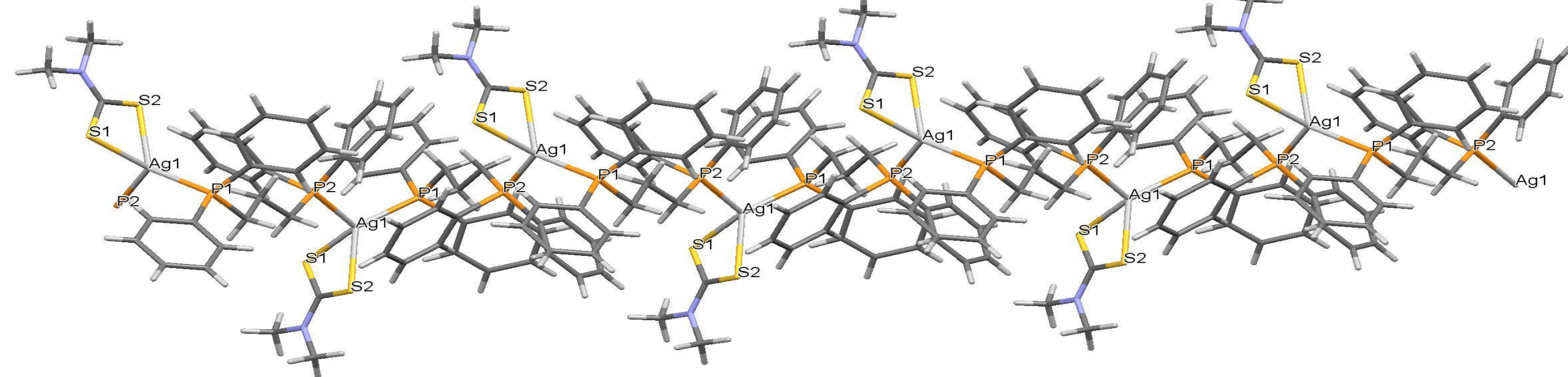
### Crystal structure of compound (1)



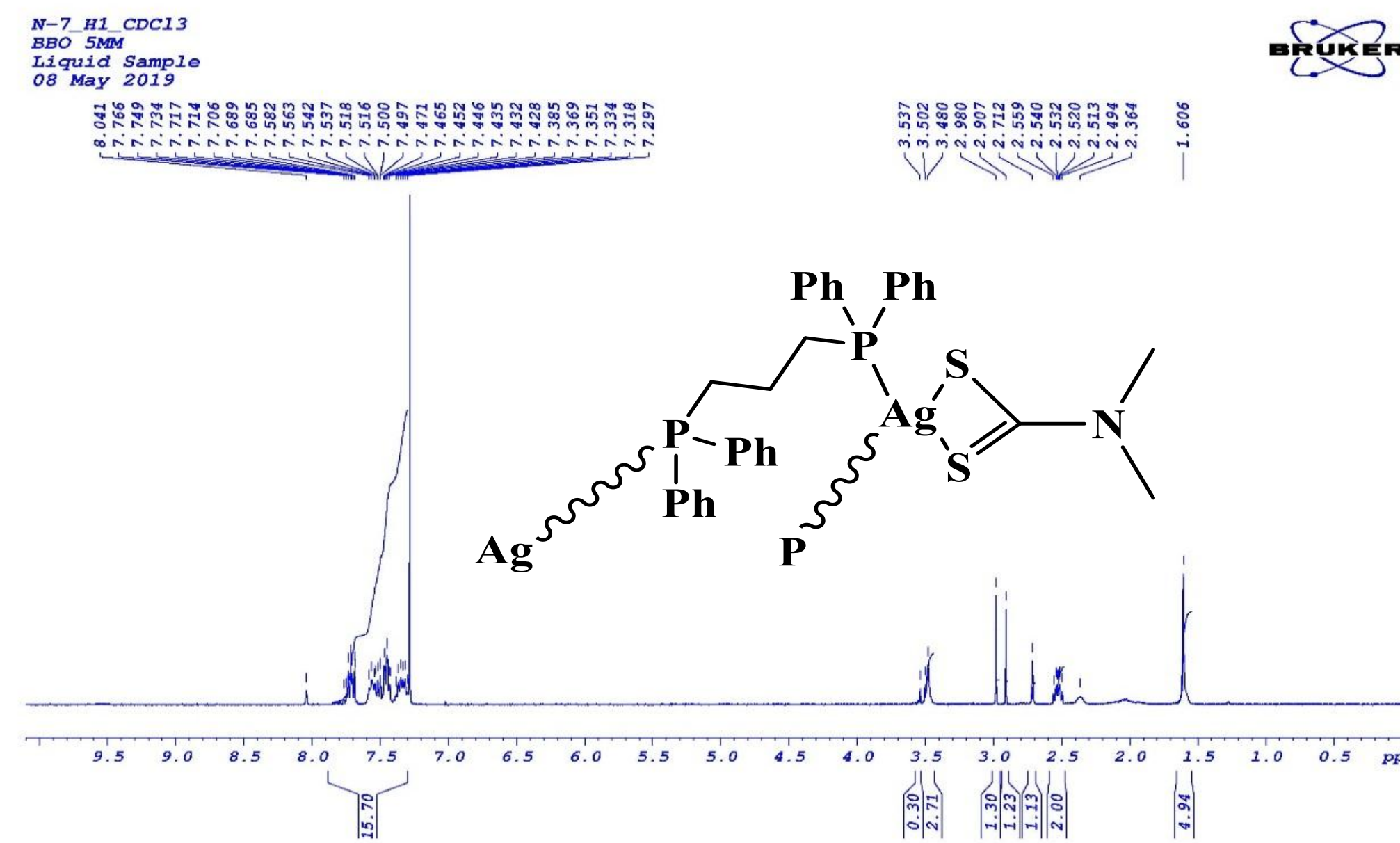
### Crystal structure of compound (4)



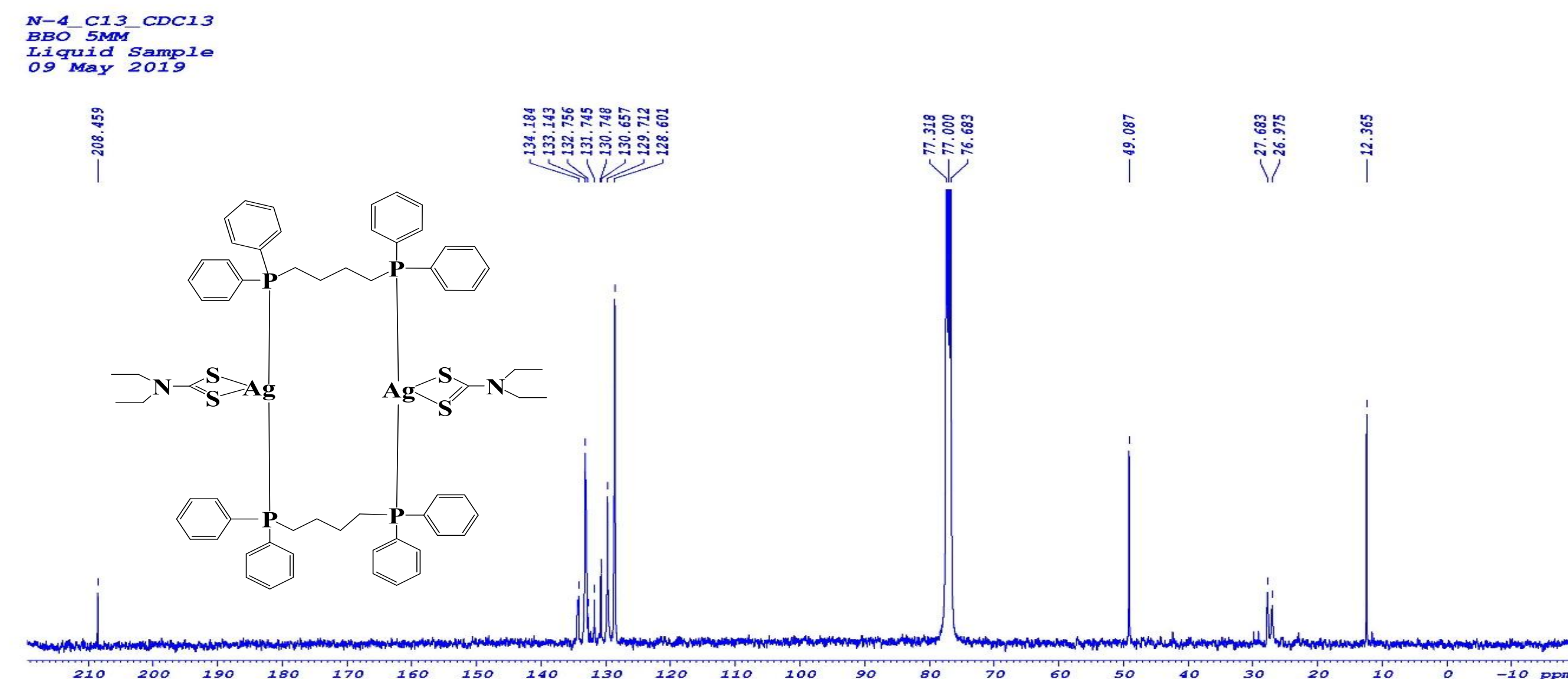
### Crystal structure of compound (1D Polymer) (3)



### <sup>1</sup>HNMR spectra of complex 3



### <sup>13</sup>CNMR spectra of complex 4



## Conclusion

To conclude, we have shown:

- Novel compounds of Ag(I) with mixed ligands like bisphosphine and dithiocarbamate.
- Characterization of synthesized compounds by elemental analysis, FT-IR, <sup>1</sup>H NMR, <sup>13</sup>C NMR and single crystal X-ray diffraction.
- Single crystal x-ray studies revealed that compound **(1)** and **(3)** is binuclear and compound **(2)** is 1-D polymer.

## Methodology

### Step 1

- Mixing the silver salt with bisphosphine in the presence of solvents

### Step 2

- Solution of DTC (DMDT, DEDT)

### Step 3

- Characterization
- Melting point, Elemental Analysis, FT-IR, NMR
- Single Crystal X-ray diffraction

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## Current and future work

- The main aim of the research project is to design the new dithiocarbamate silver(I) with bisphosphine compounds which would potentially lead to the development of new antimicrobial agents and the treatment of microbial disease effectively.
- Our work in the area of synthesis and characterization is still an ongoing project.
- We believe that with dithiocarbamate silver(I) with bisphosphine compounds we will be able to progress to the implementation of our compounds in a medicinal industry.