

## 4 CONCLUSION

In the present work, 2-(phenylazo)benzothiazole (bsazpy) was synthesized via the condensation reaction between 2-aminobenzothiazole and nitrosobenzene under the basic condition. The bsazpy was the new ligand in azoimine family which acted as bidentate ligand with two nitrogen donor atoms.

The bsazpy reacted with  $\text{RuCl}_3 \cdot 3\text{H}_2\text{O}$  in ethanolic solution to give the isomeric  $[\text{Ru}(\text{bsazpy})_2\text{Cl}_2]$  complexes. The *cis-trans-cis* (*ctc*), *cis-cis-trans* (*cct*) and *trans-trans-trans* (*ttt*) with coordinating pairs in the order Cl, N [N(benzothiazole)] and N' [N(azo)] were isolated as products by column chromatography. All compounds were characterized by analytical, spectroscopic and electrochemical data.

The analytical data confirmed the composition of elements in the free bsazpy ligand and the complexes. The analytical values of three complexes were nearly identical which supported the same empirical formula of the complexes. Thus, three complexes were isomer. The molecular weights of all compounds were supported by FAB-MS data. In addition, all complexes exhibited the MLCT transitions in visible region.

The IR data supported the azoimine functional groups in the molecules of all compounds. Beside, the low-energy shift of N=N stretching peaks from the free bsazpy ligand to  $[\text{Ru}(\text{bsazpy})_2\text{Cl}_2]$  complexes were an indication of N-coordination and may be attributed to  $\text{Ru}(d\pi) \rightarrow \pi^*$  charge transitions.

The NMR data supported the structures and the configurations of all compounds. From the *ctc*-isomer spectra, H7(7') on benzothiazole ring appeared at the most downfield position whereas H9(9') and H10(10') on phenyl ring of the *cct*-isomer and the *ttt*-isomers, respectively appeared at the most downfield. These may be due to the difference in the azo group configurations which was the reason for the difference in configuration of all complexes.

Moreover, the structures of *ctc*- and *cct*-isomers were confirmed by X-ray crystallography. In both isomers, the Ru-N(azo) distances were relatively shorter than those of Ru-N(benzothiazole), indicating stronger bonding in the former. The Ru-N(azo) bond distances of the *ctc*-isomer were shorter than that of the *cct*-isomer. Thus, the *ctc*-isomer had a greater Ru( $d\pi$ )-(azo) $\pi^*$  interaction than the *cct*-isomer. This result corresponded to the higher potential Ru(III)/Ru(II) couple of *ctc*-isomer than that of *cct*-isomer. Therefore, the *ctc*-isomer was the most stable configuration. Beside, redox studied revealed that the reduction potentials of bsazpy were more positive than that of the azpy ligand. Thus, it may be concluded that bsazpy had a greater  $\pi$ -acceptor ability than azpy ligand and this may be due to greater  $\pi$ -conjugation in benzothiazole ring of bsazpy than in pyridine ring of azpy.