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REVIEW

Organotellurium Compounds: From Molecular to Supramolecular Chemistry

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Supramolecules wherein discrete molecules are held together by non-covalent interactions are well known. It is more frequent in compounds containing conformational flexible molecule and functional groups like -COOH, -OH, $-NH_2$ that can participate in weak secondary interaction, thereby dictating the self-assembly. Moreover, metal complexes with different coordinating ligands can participate in supramolecular aggregations. Organotellurium compounds due to their unique property of hypervalency, three centre bonding and secondary bonding interactions finds its way towards supramolecular chemistry. The journey of organotellurium compounds from molecular to supramolecular chemistry is depicted here with reference to some selected examples.

Keywords: Organotellurium, Self-Assembly, Supramolecular associations, non-covalent interactions, Hypervalent.

INTRODUCTION

Organotellurium compounds classify the compounds containing a carbon (organic group) tellurium (Te–C) bond [1]. These compounds came into existence with the synthesis of dimethyl telluride, the first organotellurium compound, prepared by Wohler [2] in year 1840. Later on in 1910, Lederer [3] picked the work on the synthesis of organotellurium compounds. Further, studies on organotellurium compounds in detail, are available in the literature [4-17]. Reviews on the various important aspects of organotellurium compounds *viz*. theoretical, structural, NMR, mass spectral, radiation chemistry, ligand properties and their reactivity are also available [18,19]. Haiduc and Edelmann [20] reported the chemistry of organotellurium compounds in 1999.

The synthetic routes of organotellurium compounds takes place by using (i) elemental tellurium (**Scheme-I**) (ii) tellurium tetrachloride (**Scheme-II**) and (iii) organotellurium compounds prepared by the above methods as intermediates (**Scheme-III**).

Types of organotellurium compounds

Tellurium is rich in various oxidation states with a wide range from -2 (H_2Te) to +6 (TeO_4^{2-}). Naturally occurring tellurium compounds are found in various forms based on their oxidation states, *viz*. TeO_2 (+4) and TeO_3 (+6). The +4 and +6 oxidation states exhibit more stability and are more meaningful when compared with the other oxidation states. This feature of tellurium gives the formation of innumerable organotellurium compounds *viz*. organotellurium(II) compounds (Table-1), organotellurium (IV) compounds (Table-2) and organotellurium(VI) compounds (Table -3). These compounds have been synthesized and characterized through various spectral studies. X-ray diffraction studies of selected compounds gave their geometries.

Supramolecular organotellurium compounds

Numerous examples of supramolecular organizations, formed by congregating molecular units, are seen with organometallic compounds. In organotellurium chemistry, Te---X (X = halogens, O, S) secondary interactions gives the basis of supramolecular self-assemblies. In organotellurium(IV) compounds *viz*. organotellurium dithiocarbamates (formed with ligands containing 1,1-dithio group including N,N-dialkyl dithiocarbamates) dimeric or polymeric structures were observed due to supramolecular associations through Te---S secondary bonds as discussed by King *et al*. [21]. A review by Haiduc & Zukerman [22] gives an account of various supramolecular assemblies (formed through secondary bonds) in organotellurium chemistry by explaining the active participation of Te---Te, Te---N, Te---O, Te---S and Te---X (X= Cl, Br, I) secondary non-covalent interactions. The great propensity of tellurium to form secondary interactions, which serve as organotellurium molecular Tectons (assembly of molecular units of supramolecular structures through non-covalent interactions) into supramolecular architectures is revealed by the data given by them.

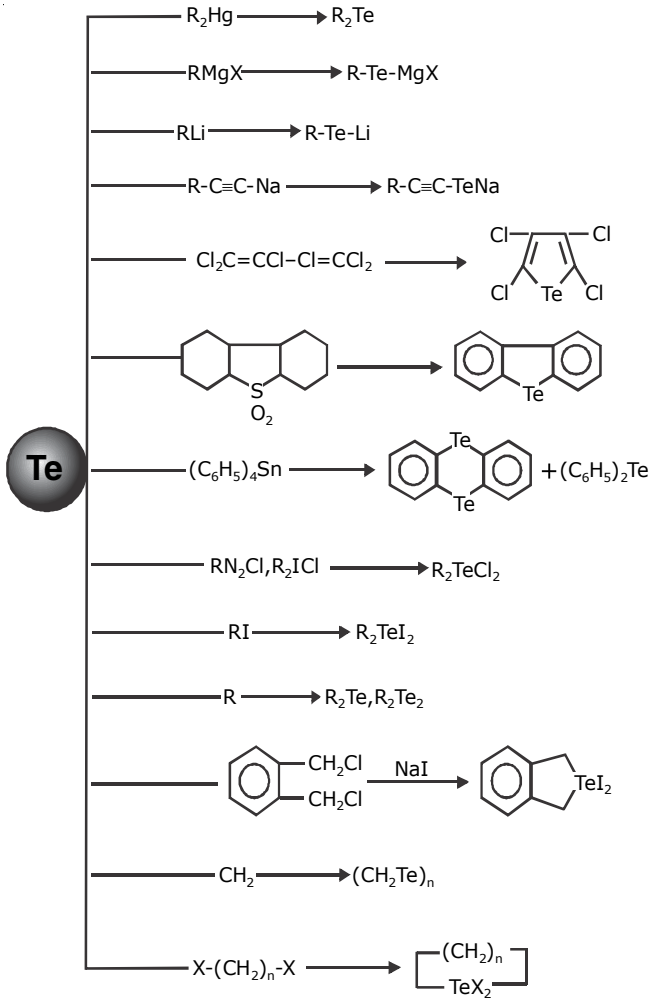
The synthesis of organotellurium(IV) derivatives of O-alkyldithiocarbonates, dithiophosphates and monothiocarbamates

TABLE-1
ORGANOTELLURIUM(II) COMPOUNDS [Ref. 58]

Type	Examples
R_2Te and RR'Te	▪ Diphenyltellurides, dialkyl tellurides ▪ Diaryltellurides RTeR' (R=R'=Ph, *p*-$CH_3OC_6H_4$; R=Ph, R' = *p*-$CH_3OC_6H_4$) ▪ Diaryl tellurides *viz.* *p*-$MeOC_6H_4TePh$ ▪ Methyl vinyl telluride ▪ *Bis*(trifluoromethyl)- and *bis*(pentafluorophenyl)tellurides ▪ N- [2-(4-methoxyphenyl telluroethyl].benzamide and N-[2-(4-methoxyphenyl telluro-propyl]phthalimide [(Te, N) type] ▪ *Bis*(triorganotellurium iodide); O-$C_6H_4(CH_2TeMe_2I)_2$ and $PhTeMe_2I$ ▪ 3,4- benzotelluracyclopentane [C_8H_8Te(II)] ▪ Telluracyclopentane [C_4H_8 Te(II)] ▪ *Bis*(*o*-isopropyl xanthate)tellurium ▪ Tellurium azamacrocycles [*bis*(2-formylphenyl)telluride + diamines]
R_2Te_2 and RR'Te_2	▪ Diphenylditellurides ▪ [*Bis*(2,4,6-triisopropyl phenyl)ditelluride] ▪ R_2Te_2 (R =Me, Et, Me_2CH) ▪ $Te_2(CF_3)_2$ and $Te_2(C_6F_5)_2$ ▪ $[(CH_3)_2Te\backslash Te(CH_3)_2]^+$, $[(CH_3)_2Te\backslash Te(CH_3)_2]^+$, $[(CH_3)_2Te\backslash Se(CH_3)_2]^+$, $[(CH_3)_2Te\backslash S(CH_3)_2]^+$ and $[(CH_3)_2Te\backslash ICH_3]^+$
RTeX	▪ 2-Formyl phenyl tellurium derivatives, RTeX (X=Cl, Br, I, CN, SCN, SeCN) ▪ PhTeI, (*p*-tolyl)TeI, (2-naphthyl)TeI ▪ TeLBr, TeLCl [L = $(C_2H_5)_2NCS_2$]

TABLE-2
ORGANOTELLURIUM(IV) COMPOUNDS [Ref. 58]

Type	Examples
$RTeX_3$	▪ 2-biphenyl tellurium tribromides ▪ RTe(teto)X_3 (X= Cl, Br, I; teto = tetraethyl dithioxamide) ▪ Phenyl tellurium triiodide, Phenyl tellurium trichloride and Phenyltellurium tribromide ▪ (α-naphthyl)TeI_3
R_2TeX_2	▪ (α-Me_2TeI_2), α-Me_2TeBr_2, (α-Me_2TeCl_2) ▪ Tetraphenyl dichalcogenoimido diphosphinates *viz.* $[C_4H_8TeI\{Ph_2(Se)PNP(Se)Ph_2\}]$, $[C_4H_8TeI\text{-}\{Ph_2(Se)PNP(Se)Ph_2\}$, $\{C_4H_8TeI\{Ph_2(S)PNP(S)Ph_2\}]$, $[C_8H_8TeI\text{-}\{Ph_2$ (S)PNP(S)$Ph_2\}]$, $[C_4H_8Te\text{-}\{Ph_2(S)PNP(S)Ph_2\}_2]$ ▪ $R_2Te(N_3)_2$ (R= Me, Ph) ▪ Biphenylene tellurium(IV) dichloride ▪ Diaryl tellurium dihalides $(p\text{-}RC_6H_4)_2TeCl_2$ (R= H, CH_3O) ▪ Telluracyclohexane-1,1-diiodide ($C_5H_{10}TeI_2$); $C_5H_{10}TeX_2$ (X = F, Cl, Br, CN, NCO, NCS, NCSe, N_3) ▪ Diorganotellurium (IV) *bis*(salicyaldehyde) $[R_2Te(p\text{-}OC_6H_4CHO)_2]$ (R = Ph, Me, *p*-$MeOC_6H_4$) ▪ $Me_2Te[C_5(CO_2Me)_5]_2$ ▪ $C_6H_{16}OSi_2Te$ and its derivatives. ▪ 2-Methyl-1-organo-1-halo-telluracyclopentane (R = Me, Et, allyl, $PhCH_2$, Ph, Cl, Br, iodo; R' = Cl, Br, iodo, BPh_4) • Diphenyl *bis* (N,N-dialkyl dithiocarbamates) tellurium(IV) and chlorodiphenyl (N,N-dialkyl dithiocarbamato)tellurium(IV) *viz.* $Ph_2Te(S_2CNR_2)_2$ (R = Me, Et), $Ph_2TeCl\text{-}(S_2CNR_2)$ ▪ Diphenyl tellurium(IV) monothiocarbamates *viz.* $Ph_2Te[SCONEt]_2$, $Ph_2TeCl[SCONEt]_2$. ▪ $C_5H_{10}TeCl(S_2CNHC_6H_5)$ ▪ Me_2TeBr_2, $Me_2Te(OCOC_6H_5)_2$ ▪ *m*-oxo*bis*(1,1,2,3,4,5-hexahydro-1-nitrato tellurophene) ▪ $[C_4H_8TeI(S_2PMe_2)]$, $[C_4H_8TeI(S_2PEt_2)]$, $[C_4H_8TeI(S_2CNC_4H_6)]$, $C_4H_8TeI(SOCNC_5H_{10})]$,$[C_4H_8TeI(S_2CNEt_2)]$ ▪ $R(OCOR')_2$ [R= CH_3, $C_5H_{10}Te$, C_8H_8Te ; R' = OCO, C_6H_5, 4-$NO_2C_6H_4$, 3,5-$(NO_2)_2C_6H_3$, 4-$OCH_3C_6H_4$] ▪ $(p\text{-}XC_6H_4)_2TeCl_2$ (X = H, Me, MeO), $(p\text{-}MeOC_6H_4COC\text{-}H_2)_2TeBr_2$ ▪ $[4\text{-}MeC_6H_4COCH_2)Ph_3P]_2[TeBr_6]$ ▪ $[PhTe(CH_3)_2]_2[TeX_6]$ (X = Cl, Br), $[Ph_3Te][PhTeX_4]$ (X = Cl, Br, I) ▪ CT complexes of Te(IV): $R_2TeI_2.IX$ [$R_2 = (CH_3)_2$, C_4H_8, C_5H_{10}; X = Cl, I] ▪ $C_4H_8Te[S_2P(OCH_2)_2CMe\text{-}nPr]_2$, $C_4H_8OTe[S_2P(OCH_2)_2CEt_2]_2$ ▪ R_2TeX_2, [$R_2 = (C_2H_5)_2$, $C_4H_7(CH_3)$; X = I, C_6H_5OCO, 4-$NO_2C_6H_4OCO$, 3,5-$(NO_2)C_6H_3OCO$, $C_6H_5CH{=}CHOCO$, 4-$OCH_3C_6H_4OCO$ ▪ $[(CH_3)_2TeNO_3]_2O$, $[(CH_3)_2TeOC_6H_2(NO_2)_3]_2O$, $[C_4H_8TeOC_6H_2\text{-}(NO_2)_3]_2O$ ▪ $[(R_2Te)_2OI_2$ (R = *p*-$MeOC_6H_4$, Me)] ▪ *bis*(Ferrocenyl carboxylato)telluranes ▪ $[TePR_2NPR_2Te]$ (R = Ph, *i*-Pr, *t*-Bu) ▪ $[K(18\text{-crown-}6)]_2[Te_2As_2]$ ▪ $TeI_2[(C_{13}H_{10}N_2S)_2]\cdot 4C_4H_8TeI_2$
R_3TeX	▪ Triphenyl telluronium thiocyanate ▪ Triphenyl telluronium diorganyl phosphinodithiocarbamates ▪ $(C_6F_5)_3TeCl$, $(CF_3C_6F_4)_3TeCl$ and $(CF_3C_6F_4)_3TeBr$ ▪ Trichloro-(4-methoxy phenyl) tellurium(IV)
R_4Te	▪ Tetraphenyl tellurium ▪ Tetraorganotellurium(IV) [(R_4Te) (R = Me, Bu, CH_2SiMe_3 and vinyl)] ▪ Tetramethyl chalcogens [Me_4S, Me_4Se and Me_4Te]



Scheme-I

TABLE-3
ORGANOTELLURIUM(VI) COMPOUNDS [Ref. 58]

Type	Examples
$RTeX_5$	$(C_2F_5)TeF_4Cl$, CH_3TeF_5, $(CH_3O)TeF_4Cl$
R_2TeX_4	$(C_2F_5)_2TeF_4$
R_6Te	Ar_6Te (Ar = $4CF_3C_6H_4$, C_6H_5)

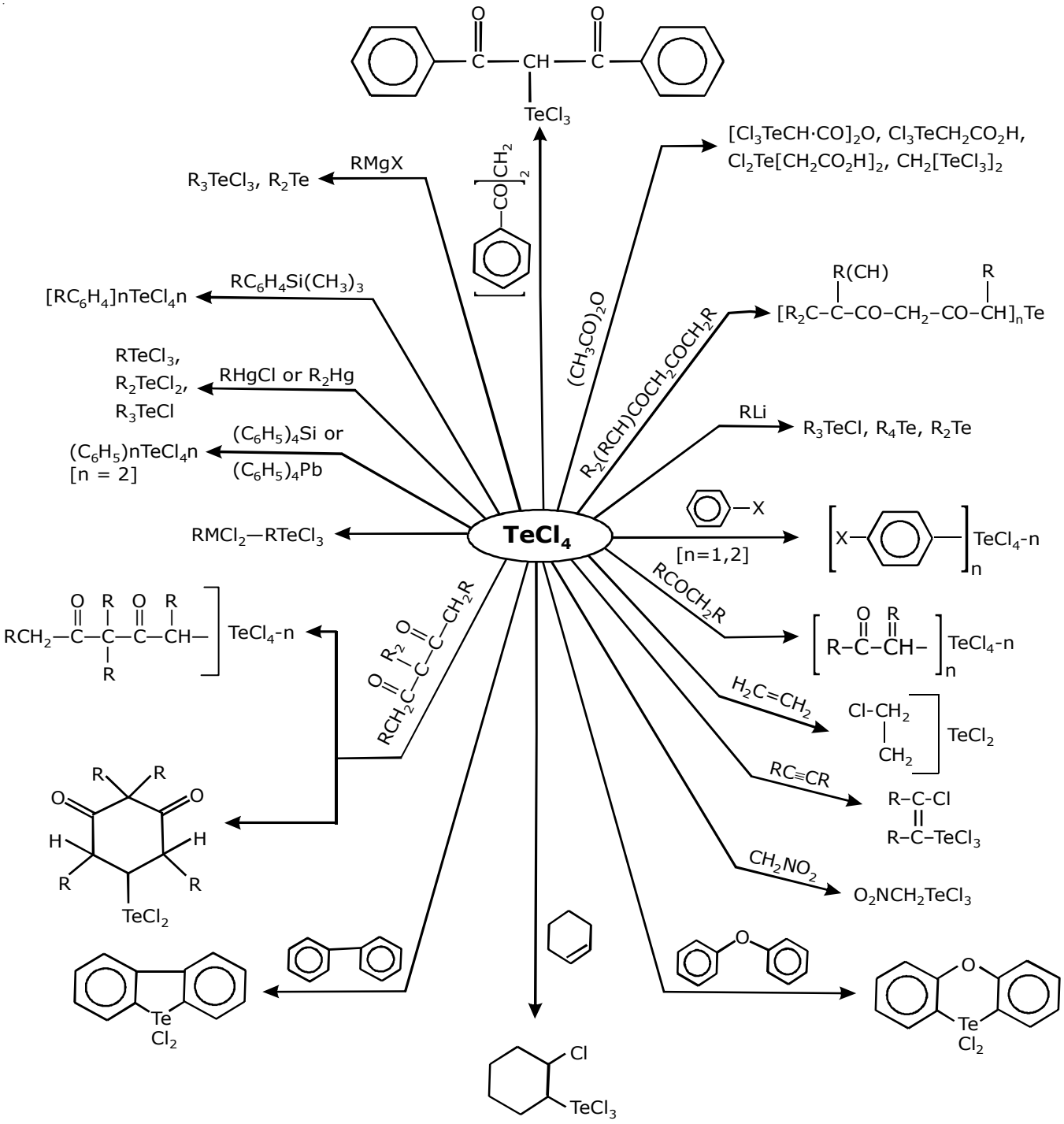
were reported by Drake *et al*. [23-27]. The structural diversity at tellurium in the complexes is observed due to (a) strong tendency to form supramolecular associations through inter- and intramolecular Te---donor atom interactions and (b) the presence of stereochemically active lone pair at the tellurium centre. Further, Dakternieks *et al*. [28-30] and others [31,32] reported supramolecular associations in organotellurium dithiocarbamates, dithiocarbonates and dithiophosphates formed through Te---S secondary interactions.

These complexes have been characterized by elemental analyses, IR, (^{1}H, ^{13}C, ^{31}P, ^{125}Te) NMR, mass spectroscopy and single crystal X-ray diffraction studies. Dimeric species in $C_4H_8TeI(S_2CNC_4H_6)$, $[C_4H_8TeI_2]_2$ and $[C_4H_8TeI(SOCNC_5H_{10})]$ are observed through intermolecular Te---S and intramolecular Te---I secondary bonds, respectively. The intermolecular Te---S secondary interactions in $[C_4H_8TeI(S_2PMe_2)]$, $[C_4H_8TeI(S_2PEt_2)]$ and $[C_4H_8TeI(S_2CNEt_2)]$ results in the formation of unidimensional polymer. The geometry around Te(IV) is distorted trigonal bipyramidal. All the structures of organotellurium compounds possess different types of supramolecular associations. Supramolecular associations of mono and bis (dialkyl-, diaryl dithiocarbamates) of type R_2TeX_2 (where R = C_4H_8, C_5H_{10} and C_8H_8: X = O, Cl and I) built up through Te---S secondary interactions and/or C-H---X (X = O, Cl, I) hydrogen bonds are also reported [33].

Singh *et al*. [34] reported the stabilization of novel low valent organotellurium compounds on incorporating [2-[1-(3,5-dimethyl phenyl)-2-naphthyl]-4,5-dihydro-4,4-dimethyl-hyloxazole, influenced by both (a) steric effects and (b) Te---N intramolecular non-bonded interactions. The synthesis was achieved by organolithium route. All the compounds were characterized by elemental analysis, IR, (^{1}H, ^{13}C, ^{125}Te) NMR and mass spectroscopic studies. The single crystal X-ray crystallography studies confirmed the presence of Te---N intramolecular non-bonding secondary interactions in all the compounds. Syntheses of monosubstituted dithiocarbamates compounds containing organotellurium(IV) heterocyclic group *viz*. $C_4H_8OTeI[S_2CN(CH_2CH_3)_2]$, $C_5H_{10}TeI[S_2CN(CH_2CH_3)_2]$, $C_4H_8TeI[S_2CN(CH_2CH_3)_2]$, $C_8H_8TeI[S_2CN(CH_2CH_3)_2]$,$C_4H_8OTeI[S_2CN(CH_2CH_3)_2]$ and $C_5H_{10}TeI[S_2CN(CH_2CH_3)_2]$ are reported [35]. These compounds were characterized by IR, multinuclear NMR (1H, ^{13}C and ^{125}Te) and EI-MS spectroscopic studies. The structures of some of these compounds were unambiguously established by single crystal X-ray diffraction studies. The synthesis and characterization of mixed-ligand diorganotellurium (IV) compounds containing dithiocarbamates and dithiophosphate ligands are also reported [36].

Srivastava *et al*. [37] reported a self-assembly through Te---I and I---I intermolecular non-covalent interactions in R_2TeI_2 type complexes *viz*. $C_4H_8TeI_2$, $C_5H_{10}TeI_2$ and $C_8H_8TeI_2$ resulting in 2D zig-zag ribbons in $C_4H_8TeI_2$, trimeric molecular aggregates in $C_5H_{10}TeI_2$ and 3D polymer in $C_8H_8TeI_2$ is reported. The structures of all these heterocyclic organotellurium diiodides were confirmed by single crystal X-ray diffraction studies. In each case, existence of distorted octahedral (six coordinated) geometry around Te atom with Te---I and I---I secondary bonds is observed, leading to the formation of supramolecular assemblies. Srivastava *et al*. [38] also reported charge transfer (CT) complexes formed through $n\rightarrow\sigma^*$ orbital interactions, where hypervalent Te---I bonds of telluranes [$C_4H_8TeI_2$, $C_5H_{10}TeI_2$ and α-Me_2TeI_2) are utilized to form the charge transfer (CT) complexes. A prodigious binuclear species $C_8H_{16}Te_2I_6$ [IC_4H_8TeI-I---I-IC_4H_8TeI] is formed whose bridging I_2 acts as a supramole-cular glue. One of the iodine atom of this I_2 molecule is exo-bound to Te of another $C_4H_8TeI_2$ molecule through weak Te---I contact making (formally) a trinuclear species. In the unit cell, such two trinuclear species are connected together through weak Te---I interactions thereby resulting in overall prolonged structure, hexanuclear species containing Te_2I_2 square.

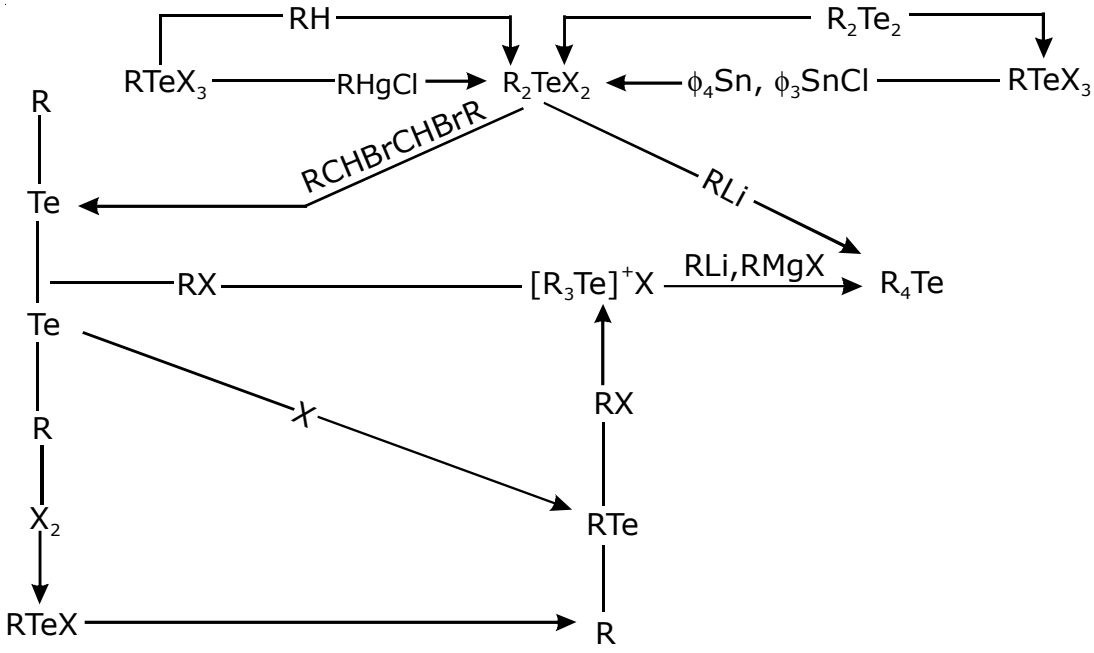
$C_5H_{10}TeI_4$ (formed through reaction of $C_5H_{10}TeI_2$ with I_2), an analogue of I_2 adduct of acyclic dimethyl diiodotellurane Me_2TeI_4 (obtained by their action of Me_2TeI_2 with ICl) corresponded to complex of different structural motif where iodine molecules are on both sides bonded to iodine atom of hypervalent Te-I bond of $C_5H_{10}TeI_2$ molecule. The supramolecular



Scheme-II

associations in cyclic tellurane[1,1,2,3,4,5,6-heptahydro-1,1-dichlorotellurane] $C_5H_{10}TeCl_2$, where tetrameric molecular aggregates assisted by Te---Cl secondary bonds are observed [39]. These tetramers are further associated through long Cl---Cl contacts to yield octameric molecular aggregates.

Srivastava *et al*. [40] synthesized several cyclic telluranes *viz*. $C_4H_8TeCl_2$, $C_4H_8TeBr_2$, $C_5H_{10}TeBr_2$,$C_8H_8TeCl_2$, $C_8H_8TeBr_2$ and described the formation of 2D stairs in $C_4H_8TeCl_2$, two dimensional ribbons in $C_4H_8TeBr_2$, trimeric molecular aggregates in $C_5H_{10}TeBr_2$ and three dimensional supramolecular networks in $C_8H_8TeCl_2$ and $C_8H_8TeBr_2$, formed through intermolecular Te---Cl and Te---Br secondary non-covalent interactions. Further secondary bonding interactions in *para*-substituted diphenyl tellurium dichlorides *viz*. $(p\text{-}XC_6H_4)_2TeCl_2$ [X = H, CH_3, OCH_3) confirmed by $^{13}C/^{125}Te$ NMR, CP-MAS spectroscopy along with the crystal and molecular structure of $(p\text{-}MeC_6H_4)_2TeCl_2$ have been reported [41]. Supramolecular self-assembly (through Te---X secondary bonds) in the solid state structure of 1,1,3-trichloro-2,4,5,6-tetrahydro-1*H*-1 4-benzotellurophene has been reported [42]. The structure unveils a hexagonal framework made up of four membered Te_2Cl_2 and 12-membered Te_6Cl_6 rings formed by self-assembly of Cl-Te-Cl rods through Te---Cl



Scheme-III

secondary non-covalent interactions into a supramolecular two dimensional network.

Te---X (X = halogens) secondary bonding interactions in the crystal structure of $[R]^+[PhTeCl_4]^-$ (R = C_5NH_6, 2-Br-C_5NH_5-{2-Br-C_5NH_5}{$Co(NH_3)_4Cl_2$}$[PhTeCl_4]_2$ have been reported [43], which shows an unique face to face packing of $[PhTeCl_4]^-$ anions through hydrogen bonding to bromopyridinium cations. Cyclic and acyclic organotellurium(IV) dicarboxylates describing the secondary bonds induced supramolecular assemblies in the crystal structures of Et_2TeI_2, $Et_2Te(C_6H_5OCO)_2$, $Et_2Te(4\text{-}NO_2C_6H_4OCO)_2$, $Et_2Te\{3,5\text{-}(NO_2)_2C_6H_3OCO\}_2$, $Et_2Te(C_6H_5CH{=}CHOCO)_2$, $Et_2Te(4\text{-}OCH_3C_6H_4OCO)_2$, $C_5H_{10}Te(OCOC_6H_5)_2$, $C_8H_8Te(OCOC_6H_5)_2$, $C_4H_7(CH_3)Te(OCOC_6H_5)_2$ and $C_4H_7(CH_3)$-$Te(OCOC_6H_4NO_2\text{-}4)_2$ have been reported [44,45]. All these compounds possess immediate pseudo-trigonal bipyramidal coordination geometry around tellurium, where axial positions are occupied by two oxygen atoms of unidentate carboxylate groups, two methylene carbons (attached to Te) of C_5H_{10}, C_8H_8 groups and one methylene carbon, one methene carbon (attached to Te) of $C_4H_7(CH_3)$ group and the stereochemically active electron lone pair occupies equatorial positions. Polymeric supramolecular associations due to Te---O secondary bonds are present. Diphenacyltellurium dibromide $(PhCOCH_2)_2TeBr_2$ and diphenacyltellurium diiodide $(PhCOCH_2)_2TeI_2$, the first examples of functionally substituted organotellurium halides have been reported by Chauhan *et al.* [46] along with their synthesis, characterization and crystal structures which reveals the immediate pseudotrigonal bipyramidal geometry about the central Te atom with axial halogens in both thecompounds. Stereochemically active lone pair of electrons occupies the equatorial plane. Te---O intramolecular interactions through carbonyl O atom is observed. Presence of hydrogen bonds in organometallic crystals and C-H---O hydrogen bonds inbridged and terminal first-row metal carbonyls have been investigated by Braga *et al.* [47].

Desiraju [48] evaluated the role of C-H---O hydrogen bonds in the independent crystal structures. For the first time, we have been able to detect C-H---O hydrogen bonds in organotellurium complexes [49]. In all the complexes *viz.*, $Me_2Te(OCOC_6H_5)_2$, $C_5H_{10}Te(OCOC_6H_5)_2$, $C_4H_8Te(OCO_4\text{-}NO_2C_6H_4)_2$ and $C_4H_8Te(OCOCH{=}CHC_6H_5)_2$, the immediate environment about Te is distorted trigonal bipyramidal with a stereochemically active electron lone pair. The complexes shows intermolecular C-H---O hydrogen bonds which lead to the formation of supramolecular assemblies.

Recently synthesis, characterization and reactivity of *para*-substituted benzoylmethyl tellurium(II and IV) compounds along with intermolecular C-H---O hydrogen bonds and Te---O secondary bonds in $(p\text{-}MeOC_6H_4COCH_2)_2TeBr_2$ [50] and in acylmethyl(aryl) tellurium(IV,II) derivatives have been reported by Chauhan *et al.* [51]. Self assemblies of organosulfur, selenium and tellurium compounds *via* stacking and hydrogen bonding interactions have been reported by Kersting [52]. The tellurium derivative has an unprecedented 3D-network structure held together *via* stacking and hydrogen bonding interactions.

Srivastava *et al.* [53] further reported stairs of cyclic tellluranes (1,3-dihydro-2λ^4-benzotellurole-2,2-diyldicinnamate) $[C_8H_8Te(OCOCH{=}CHC_6H_5)_2]$ assisted by intermolecular Te---O secondary bonds and C-H---O hydrogen bonds. It accounts for the rare example in organotellurium chemistry, containing both intermolecular- and intramolecular Te---O secondary bonds acting as crystal structure directors to yield stair type supramolecular association assisted by C-H---O hydrogen bonds. This report also demonstrates the cooperative effect of intermolecular and intramolecular Te---O secondary bonds and intermolecular C-H---O hydrogen bonds.

The comparative account of supramolecular associations [45] present in $C_4H_7(CH_3)TeI_2$, $C_4H_7(CH_3)Te(OCOC_6H_5)_2$, C_4H_7-$(CH_3)Te(4\text{-}NO_2C_6H_4OCO)_2$ and $C_4H_8TeI_2$ demonstrated that zig-zag two dimensional ribbons present in $C_4H_8TeI_2$ are modified in $C_4H_7(CH_3)TeI_2$ (which may be formally considered as formed due to the replacement of one hydrogen of one -CH_2- group of C_4H_8Te by -CH_3 group) and they appeared as polymeric

supramolecular associations. By replacing iodine of $C_4H_7(CH_3)TeI_2$ with benzoate group (C_6H_5OCO group), polymeric supramolecular associations of $C_4H_7(CH_3)TeI_2$ are remodelled to trimeric supramolecular associations and when iodine of $C_4H_7(CH_3)TeI_2$ is replaced by 4-nitrobenzoate group (4-$NO_2C_6H_4OCO$ group), the polymeric supramolecular association of $C_4H_7(CH_3)TeI_2$ are transformed to tetrameric supramolecular association. This report demonstrates the cooperative participation of intermolecular I---I, Te---I, Te---O secondary bonds and C(sp^3) H---O and C(sp^2) H---O hydrogen bonds.

The supramolecular self-organization of tetraorganoditelluroxanes *viz.* $[(CH_3)_2Te(NO_3)]_2O$, $[(CH_3)_2TeOC_6H_2(NO_2)_3]_2O$ and $[C_4H_8TeO\text{-}C_6H_2(NO_2)_3]_2O$ are explained through cooperative participation of Te---O secondary bonds, C-H---O hydrogen bonds and π-stacking of organic substituents [54]. Supramolecular assembly of diverse structural types of organotellurium compounds in the reactions of $(4\text{-}OCH_3\text{-}C_6H_4)_2TeO$ has been reported by Chandrasekha and Kumar [55].

Recent reports from Srivastava *et al*. [56,57] envisages the supramolecular associations in various acyclic and cyclic organotellurium(IV) derivatives R_2TeX_2, R_2TeIX and R_2TeClX [$R_2 = (C_2H_5)_2$, $(n\text{-}C_3H_7)_2$, C_4H_8, $C_4H_7(CH_3)$, C_5H_{10}, C_8H_8; X = OCO-C_6H_5, $OCOC_6H_3(NO_2)_2$-3,5, OCOCH=C_6H_5, $OCOC_6H_4(NO_2)$-4, $S_2CN(C_2H_5)_2$, $S_2CNC_4H_8O$ and $S_2CNC_5H_{10}$] formed through intramolecular Te---S secondary bonds, inter-molecular Te---X (X = I, S, O) secondary bonds and C-H---O hydrogen bonds. The third order non-linear optical studies of select organotellurium compounds by degenerate four wave mixing technique using a pico-second laser was also done which inferred the presence of efficient third-order non-linear optical susceptibility. $C_4H_7(CH_3)Te[S_2CN(C_2H_5)_2]_2$ shows an efficient third order NLO susceptibility $\{\chi^{(3)}\}$ of the order of 10^{-14} esu and second order hyperpolarizability (γ) of the order of 10^{-32} esu and it opens a new field of organotellurium derivatives to be applied in the field of photonics.

Conclusion

In general, the presence of supramolecular associations in organotellurium compounds is governed by both organic group and ligands attached to tellurium. They contribute and largely determine the nature and pattern of the supramolecular associations in organotellurium compounds. This emerging area is stimulated by two parallel developments (a) synthesis of novel tellurium agents with specialized properties and (b) the detailed evaluation of their reactivity and mechanisms associated with these compounds. The supramolecular associations in organotellurium compounds generated through cooperative Te---S, Te---I secondary bonds and C-H---O hydrogen bonds may be utilized as 'rescue agents'. In future, the unique properties of tellurium compounds will definitely place them in various technological applications.

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